Advanced Technology for Grinding of Aluminium Alloys Parts

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In the presents the aluminium and its alloys is doing high advanced technical materials whose proprieties use in the automotive and aerospace industry. In the production of products is effort of producer to production of parts quality and machine with acceptable price. The machining is making important portion by production of the machine parts of automotive industry. The long-terms opinions on the grinding of aluminium alloys in relation to lost of cutting power (glued up of wheel and impaction of pores) important terms there are not so use for aluminium alloys grinding and surface quality. The competition of grinding to advanced production method e.g. forming and turning with advanced tools do not threat dominance of these methods. The use of grinding we are finding in the minor series of production where the use of CNC and forming machines is not suitable in view point of price. The customer requirement of quality (roughness and geometrical accuracy) by grinding of aluminium alloys is guaranteed and correspond with normal and precision grinding e.g. for steels and hardened steels.

Keywords: Aluminium alloys, grinding, surface quality

1 Introduction

Aluminium alloys belongs to progressive materials which presently finds use in many applications and industrial branch e.g. automobile industry, aviation, railway and others. Especially in the automobile and aviation industry is this material very used for automobile body, rotary parts (wheels) [4].

Traditional methods of aluminium alloys processing are founding, forming, machining and others. This experiment deals with aluminium alloys grinding possibilities like machining operation at parts production. By use of the traditional methods of machining with defined geometrical of edge are problems with creation of build-up at the secondary plastic deformation.

Mechanical proprieties of aluminium materials are given its chemical composition. Different chemical elements in a way are influencing subsequently proprieties machined materials. Workability of these materials depend on the chemist and with it joint mechanical proprieties [5]. Low melting point of aluminium is important information for setting of technology of machining including kind of tool material, cutting speed, speed of workpiece, feed and coolant.

During grinding is higher temperature balance than for example during turning and milling. Regarding to fundamental of grinding process there are many grains all at purchase is not this method for machining of aluminium alloys too acceptable in depend on heat rising during grinding [1].

Aluminium alloys passes through special methods surface adjustment called by anodic oxidation. This process rests in chemical process on the surface when the surface is coated thin of protective layer. For that reasons we are evaluating surface profile and surface roughness including material portion of the surface profile in this experiment. Size and shape of the surface profile and material portion of the surface profile are important dates for determination of pertinence concrete surface for anodic oxidation [8].

2 Experiment

This experiment with aluminium alloys grinding was carry out in laboratory of Science and Technology Institute of the faculty. There are many instruments (grinding machine, sensors, measurement devices), devices and machines in park which used during experiment.

2.1 Material of aluminium alloys

The materials of experiment was used three groups of aluminium alloys, circular profile for recess grinding. Fundamental of the experiment is find of such cutting conditions that could have been these materials grounded. Each material had various chemist which is for experiment very important on the base of cutting conditions possibilities use.

Materials of aluminium alloys was (after EN ISO mark)

- EN AW 7075 (AlZn alloy)
- EN AW 2007 (AlCu alloy)
- EN AW 6082 (AlMgSi alloy)

2.2 Cutting conditions

During prepare of the experiment was proposed two kind of abrasive grain (material of grinding wheel) including others components of the wheel (porosity, granularity and bond) [2]. Grain of the grinding wheel was on base Al_2O_3 – SG (microcrystalline corundum) and SiC (carborundum). In terms of running research will be not more closely specify kind and mark of SG and SiC grinding wheels.

Next factor of the cutting conditions were cutting speed of grinding wheel and speed of workpiece. In this part of experiment we are looking for in the technical bibliography how makes right possible with both speeds during grinding. We have not so experience with set of cutting speed of tool a speed of workpiece was rather experimental in depend on evaluated surface roughness, surface profile and material portion of surface profile. This part with experimental set of conditions was used for infeed too.

Coolant of the grinding process was used special emulsion (water solution with special emulsion). On the fig. 1 you can see the grinding workplace with grinding machine, movement regulation, coolant regulation and cutting forces sensors.

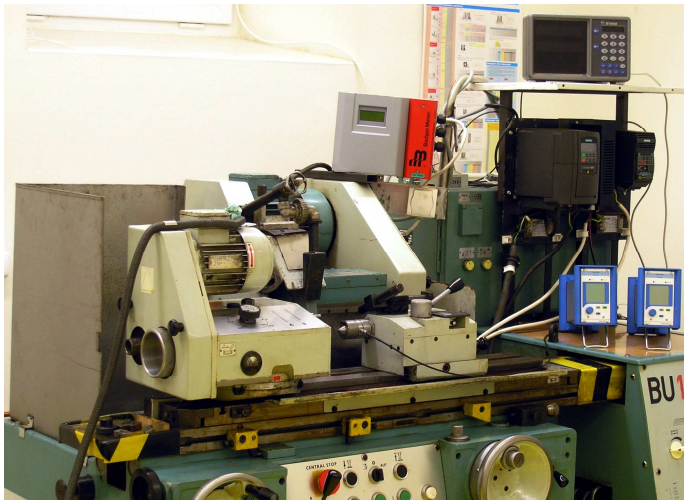


Fig. 1Grinding workplace with sensors

For this experiment began we mainly with the evaluation of surface roughness we are checking used cutting conditions during grinding and its influence on surface quality of aluminium alloys. Parameters of surface roughness are very important in production and therefore devote to focus on him. By use of ISO standards we are evaluating surface roughness and profile with the parameters Ra, Rz, Rt, surface profile and material portion of surface profile (Abbott-Fireston curve) [6].

3 Evaluating of ground aluminium alloys surface profile

This chapter evaluates obtained data form experiment with aluminium alloys grinding. They will be showed and described results of measuring on particular materials.

3.1 The parameters of surface roughness

Evaluating of surface roughness was performed by used of ISO Standards (EN ISO 4287) with Ra, Rz and Rt parameters. All parameters were measured by an instrument Hommel Tester T1000.

On the fig. 2 you can see graph with values of surface roughness in parameters Ra, Rz and Rt. Parameter Ra is not so suitable for right evaluating of surface roughness but it is very use that is evaluated here.

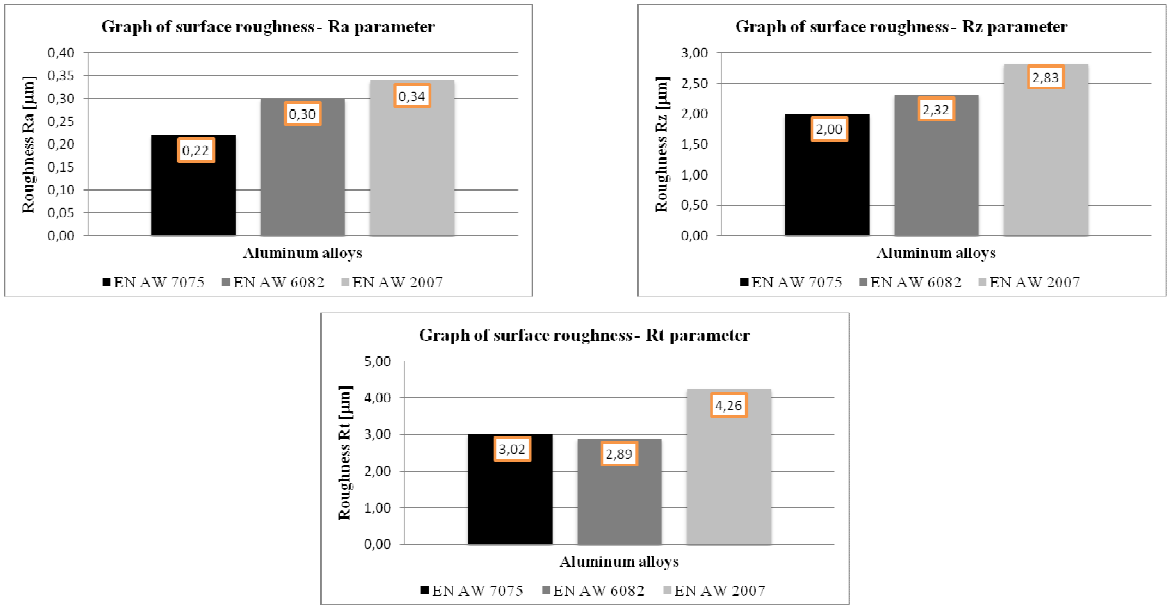


Fig. 2 Surface roughness, parameter Ra, Rz and Rt

All samples was ground by same cutting conditions. Values of surface roughness by parameter Ra is the best for EN AW 7075 aluminium alloy with 0.22 µm. This values is in bottom limits for grinding and surface roughness nears to fine grinding. All alloys have very good values of surface roughness how show other parameters – Rz and Rt.

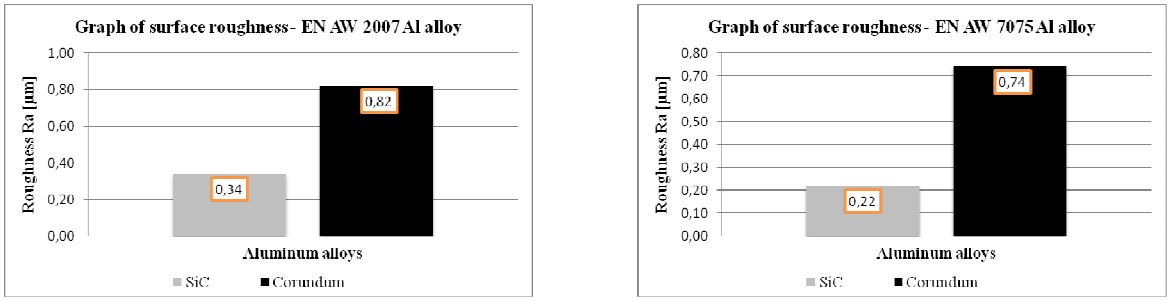


Fig. 3 Surface roughness – parameter Ra, different grinding wheels

On the fig. 3 you can see surface roughness for two different Al alloys grounded under same cutting conditions (cutting speed, infeed, coolant) but with different grinding wheel (SiC grain, SG grain). Parameter Ra shows better surface roughness for both Al alloy by use SiC grinding wheel. Compared to the second grinding wheel (SG) we can see worse surface roughness in Ra parameter.

How shows fig. 2 and fig. 3 by use of SiC grain of grinding wheel we have surface quality in bottom limits for grinding (0.2 – 0,8 µm). With SG grinding wheel we have limiting values in upper limits for grinding. Though both values of the surface profile (parameter Ra) corresponding with limits for grinding.

3.2 Evaluation of surface profile

Surface profile is important part by evaluation of surface quality [3]. For subsequently process anodic oxidation we have to know how the profile looks [7]. Profile consists of many valley and many peaks. From graphic image of profile we can deduce pertinence for given using.

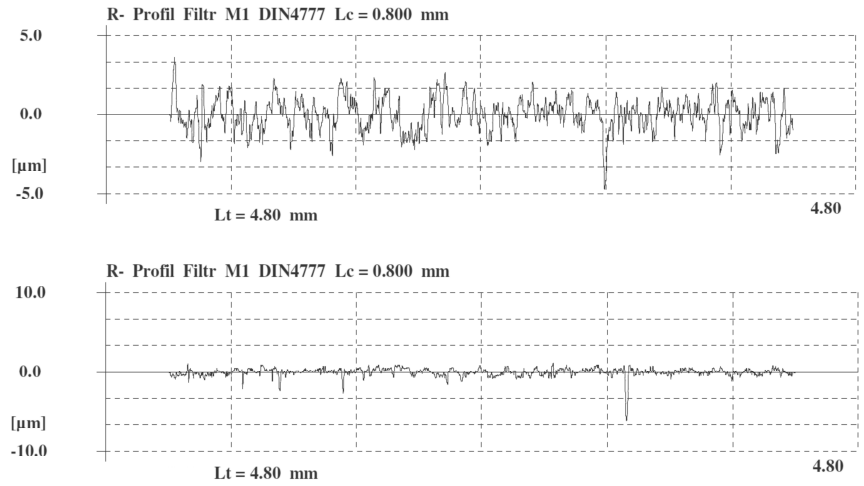


Fig. 4 Surface profile of EN AW 2007 alloy

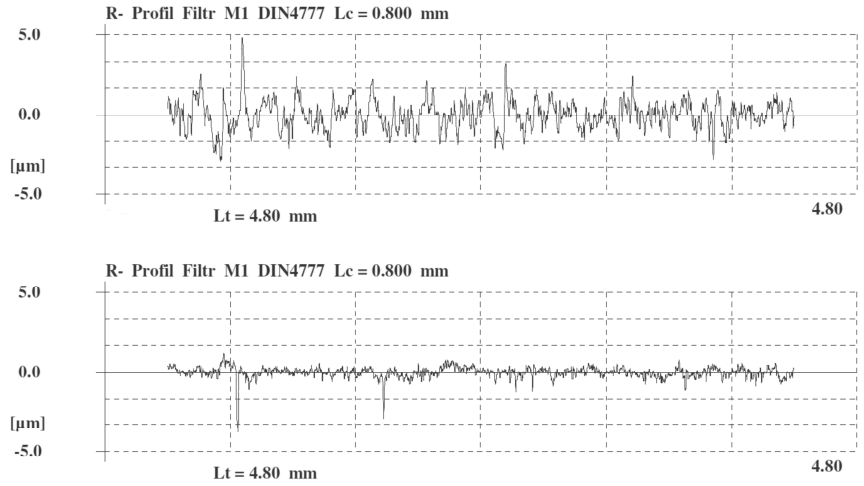


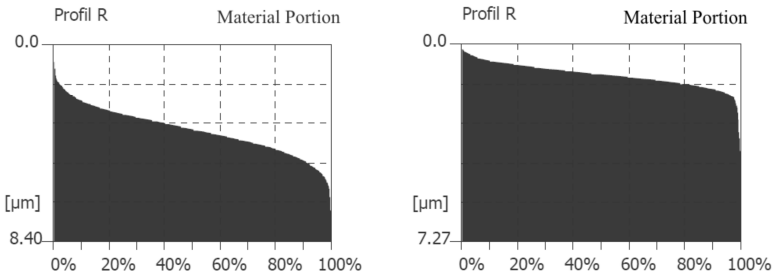
Fig. 5 Surface profile of EN AW 7075 alloy

On the fig. 4 and fig. 5 are showed surface profiles of two Al alloys EN AW 2007 and EN AW 7075 ground with two different grinding wheel. We can see low profile i.e. minimal distance between valley and peaks for SiC grain. On the contrary surface profile by used of SG grain shows larger distance of profile.

For subsequent using at machine and other applications are these data important for assessment pertinence concrete part for consequent process conditions. Especially by mutual movement of more parts are important problems about creation of clearance and change of purchase of mechanical parts of machine including decrease of accuracy.

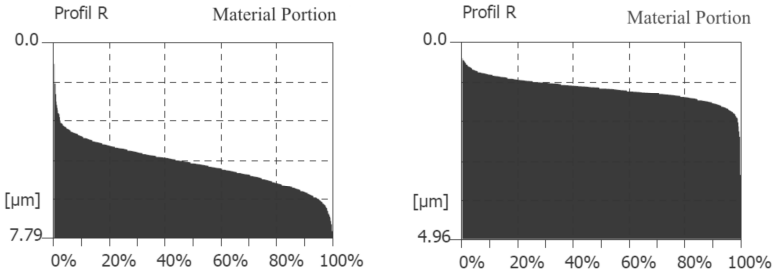
3.3 Evaluation of material portion of surface profile

Material portion of surface profile shows quantity of material in peaks against quantity of air in valley. These curves (or surface) are important for individual finished operations of machining evaluation in light of appraisal of functionality machined surface, their loads and problems of wear and durability. The parameters of these curves are value R_{pk} a R_{vk}, which describes profile of surface in light of quantity peaks and valleys in base profile of surface.



SG grinding wheel SiC grinding wheel

Fig. 6 Material portion of surface profile of AW 2007 alloy



SG grinding wheel SiC grinding wheel

Fig. 7 Material portion of surface profile of AW 7075 alloy

On the fig. 6 and fig. 7 we can see material portion of surface profile by two Al alloys. Material portion is better with SiC grinding wheel using than SG grinding wheel. By use of SiC we can see quantity of full material in surface profile. On the contrary by use of SG grain we can see quantity of "missing" material in surface profile.

4 Results and discussion

This experiment shows possibilities for Al alloys grinding. Grinding is not belong to currently used methods machining this materials but is possible to achieve surface quality in limits for grinding. This result come up also this experiment that is possible successfully to grind different Al alloys.

Fundamental of successfully grinding of Al alloys are suitable select cutting conditions, especially grain of grinding wheel, cutting speed and kind of use coolant. *"Is problems find of correct conditions for Al alloys grinding"?* No, this experiment shows that it is possible!

Good results with grinding of the aluminium alloys we can get with the grinding wheel containing carrborundum grains and special coolant for non-ferrous material.

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