STUDENT WORK DURING PREPARATION OF MATERIAL DATASHEETS FOR SPECIFIC COMPANY

Natasa Naprstkova[1], Pavel Kraus[1], Dana Stancekova[2]
[1]Jan Evangelista Purkyně University in Ústí nad Labem, Czech Republic;
[2]University of Žilina, Slovakia
naprstkova@fvtm.ujep.cz, kraus@fvtm.ujep.cz, dana.stancekova@fstroj.uniza.sk

Abstract. The target of this article deals with the work of students during preparation of material datasheets for specific company. The students during processing the task were familiar with the process of aluminium profile production and with the methods for quality analyses of products. They gained experience in metallographic sample preparation and when using microscopy. Also, they become familiar with the chip formation in machining of selected products, because making of the required chips is an indicator of the quality of the resulting structures of the produced alloys and it is very important information for the company. Students thus gain very practical information and experiences, what is then very important for their future career placement. The work was made in the frame of a practical task from one Czech company, which is engaged in production of aluminium semi-finished products.

Keywords: education, student, practice, company.

Introduction

In training and education of engineering students a very important aspect is their solution of practical problems and practical demonstrations of techniques and methods. It does not matter what a particular field, but practical demonstrations in technical education must be an integral part of education, because these experiences contribute to better use of students in manufacturing companies. At FPTM JEPU are in the Master's degree two fields of study, namely "Management of production" and "Materials and technologies in transport" and as is already evident from their names, teaching in the field of materials and technologies is an important content of these fields. As part of this course it is important to introduce students, among other things, with the principles of metallographic sample preparation and to use various instrumentation at the faculty for various analyzes that are possible to implement in this area [1; 2].

In one research project, which was designed for a specific company that is engaged in production of aluminum alloy profile, students could just meet with the above mentioned applications. This company was interested in creating of catalog sheets of their materials, in which the chemical composition of the alloy, the processing method of the blank, heat treatment, the characteristic structure of the material and, ultimately, the characteristic chip for this material would have been observed. Such documents subsequently help the company in resolving of any complaints [3-5].

Within the solution challenges the students met with preparation of metallographic samples, when they subsequently evaluated the structure macroscopically and microscopically. Further in the selected alloys they evaluated phases and they also machined alloys on CNC lathe and then they evaluated the chips, particularly in terms of the shape. There they met with the importance of such evaluation, because the resulting chip is an indicator of the produced alloy quality, too.

Preparation of samples, macroscopic and microscopic evaluation of the structure

Within the initial experiments (collaboration with the company continues and it is possible to involve other students in this activity) were 25 samples from nine Al alloys evaluated that the manufacturer wished for this purpose.

Here the students introduced the basic steps on how to implement such analysis. They verified their theoretical knowledge of how to implement macroscopic analysis, which represented to them taking of samples, when they used a band saw. Furthermore, they had to turn the face of the sample, which was further evaluated macroscopically (here they used face turning, it was explained to them that such a surface can also be obtained by milling or grinding for these purposes). Furthermore, the rated surfaces had to be etched for observation of the material structure on the samples. Here they acquainted with the purpose of etching, but also they tested their theoretical knowledge in the field, composition and etchant types and, their concentrations [6; 7].

Specifically, their activities included taking of samples with band saws (cross-sections), then they prepared the frontal area by turning (there was care needed) to achieve the required surface quality and subsequently they etched the examination surface of the samples in 15-20 % NaOH for 3-4 minutes at temperature 60-70 ºC followed by rinsing in water. Here students have verified that it is important to devote attention to cleaning of the sample and its proper treatment. Purification of the sample was carried out in 10-15% HNO_3 solution, followed by rinsing in water and drying out. Here at the beginning the students etched some samples too much, but that is for their next performance in other practice also an interesting experience. Then they observed the macrostructures visually using the stereomagnifier ZEIS Stemi 2000-C (Fig. 1), in Fig. 2 there are samples prepared by the students for observation [6-8].

Fig. 1. **Stereomagnifier ZEIS Stemi 2000-C**

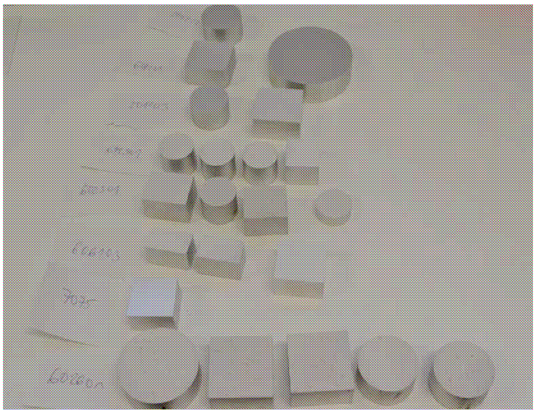

Fig. 2. **Presentation of samples for macroscopic evaluation**

Within microscopic examination, the students tried preparing the samples for two different observations. In the first case they monitored the structure of the samples in longitudinal cross section and for the selected recrystallized alloy also conducted observations of grain. In the latter case the samples were prepared for observation of the phases in alloys. For each case they used a slightly different method for preparation of metallographic samples. For observation of the grains and their shapes the so called Barker method was used, when the sample surface is finally adjusted by electropolishing. For observation of the phases, the sample was prepared by mechanical polishing. Here, the students were acquainted with sample preparation to a greater extent than is possible in the exercises, which means that the students in this area due to the fact that the task was solved for the company, got much more skills and experiences [6; 8; 9].

In the first case (electropolishing samples) the samples were prepared by conventional separating (dividing), ground (without deformation layers) and electropolished (electrolytic polisher SDP 2405, see Fig. 3). For etching of the polished surfaces the students used solution of boric acid and hydrofluoric acid with distilled water, which is a usual practice for this purpose [10].

Fig. 3. **Electrolytic polisher SDP 2405**

The students realized both kinds of observations with the laser optical microscope NIKON EPIPHOT 300 (Fig. 4). In both cases the samples were ground, or ground and polished on the apparatus JEAN WIRTZ Phoenix 2000 (Fig. 5).

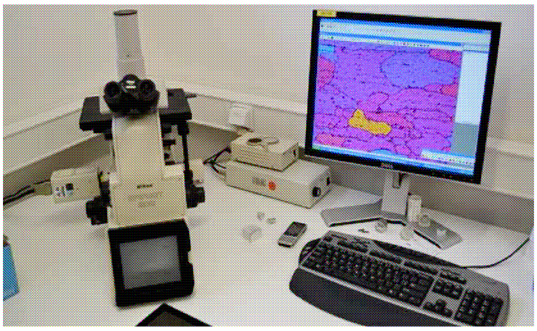

Fig. 4. **Mikroscope NIKON Epiphot 300**

Fig. 5. **Polisher JEAN WIRTZ Phoenix 2000**

Fig. 6 shows an example of the structure that has been processed by the Barker method and which was observed under polarized filtered light. In Fig. 7 is a sample of phase observation. For this purpose, the students processed the samples by mechanical polishing (as mentioned above) [9].

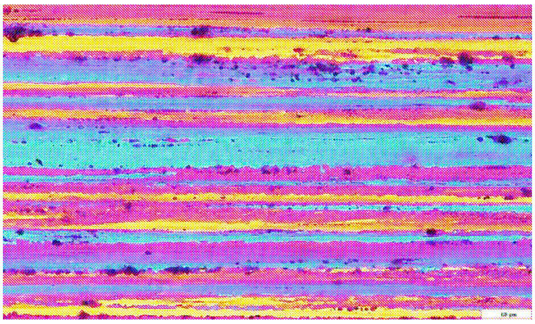

Fig. 6. **Fibrous structure in the direction of forming under polarized filtered light, 600x**

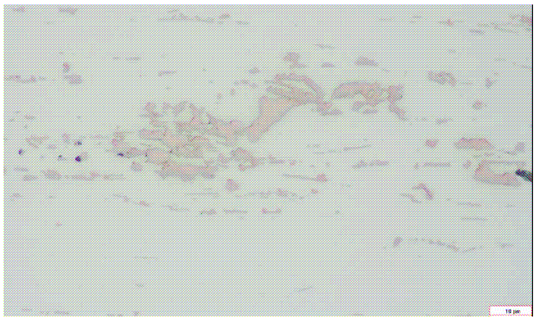

Fig. 7. **Sample of structure prepared for phase evaluation - phase AlFeCu2, 1000x**

In this area, the students tested their theoretical knowledge in the area of sample preparation for various kinds of microscopic examination, and also gained practical skills. These skills are currently often required by some companies, especially those engaged in the production of materials for further processing and it is only beneficial if the students have the opportunity to participate in such activities.

Machining, evaluation of alloys in terms of chips

The students also had to deal with the evaluation of alloys in terms of chips. Here, the students tested their technical skills. In order to have machinability rating of aluminum alloys objective the machinability test must be for all tested alloys identical. Due to the number of experiments, this was a unique opportunity to recognize that fact. During machining, the students collected chips, which they then evaluated. The chip was evaluated in terms of its shape and size and also in terms of the number of chips per 100 g, Classification of the chip in terms of the shape and size the students realized according to the standard ISO 3685 and according to the internal regulations of the company, which have been created on the basis of this standard (Fig. 8) [10; 11].

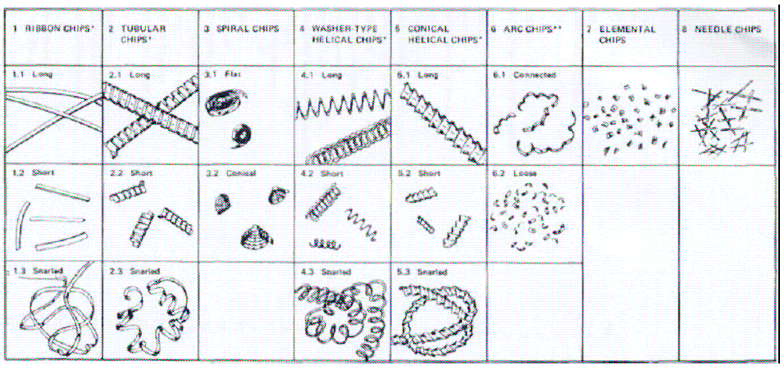

Fig. 8. **Classification of chips according to standard ISO3685 [10]**

In Fig. 8 there is an example of preparation which students did and on this basis they conducted subsequent evaluation of chips in terms of the shape and size.

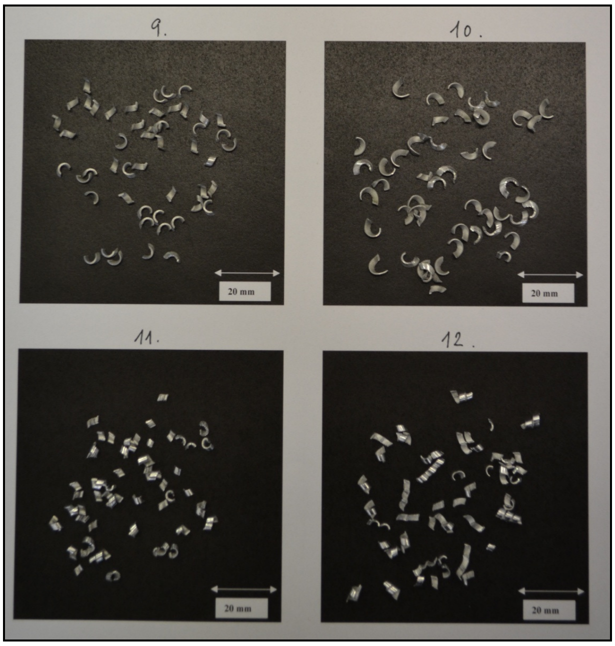

Fig. 9 **Samples of preparation for evaluation of chips in terms of shapes for the selected alloys**

In Table 1 there is a sample of the final evaluation of chips in terms of the shape and size that the students assembled. In Tab. 2 there is an example of the results of the evaluation of the chip saccording to the number of chips per 100 g of chips.

Table 1

Example of alloy evaluation according to the shape and size of the chips

Alloy	Shape and size of chip	Classification of chip
2007 (Al-Cu-Si-Pb-Mg-Mn-Fe)		5A – 7A
2011 (Al-Cu-Bi-Fe-Pb-Si)		5A – 7A

Table 2

Example of alloy evaluation according to the number of chips per 100 g

Sample	Alloy	Number of chips per 100 g
1	608201	1447
2	200701	2480
3	200701	2216
4	602601	5067

The final task, which students had to meet, was to compile classification sheets of the investigated alloys, which contain information on the alloy, its condition, melt, product, number of chips per 100 g, shape of the chips, structure, sequence machinability, ductility, strength etc. (Fig. 9). Work on such a document provides important experience in terms of what information about the material is important for the company, as it might appear a document that is then an important aid in the identification of defects in materials or complaint procedure. It is therefore not only experience in processing of materials but also in management of production.

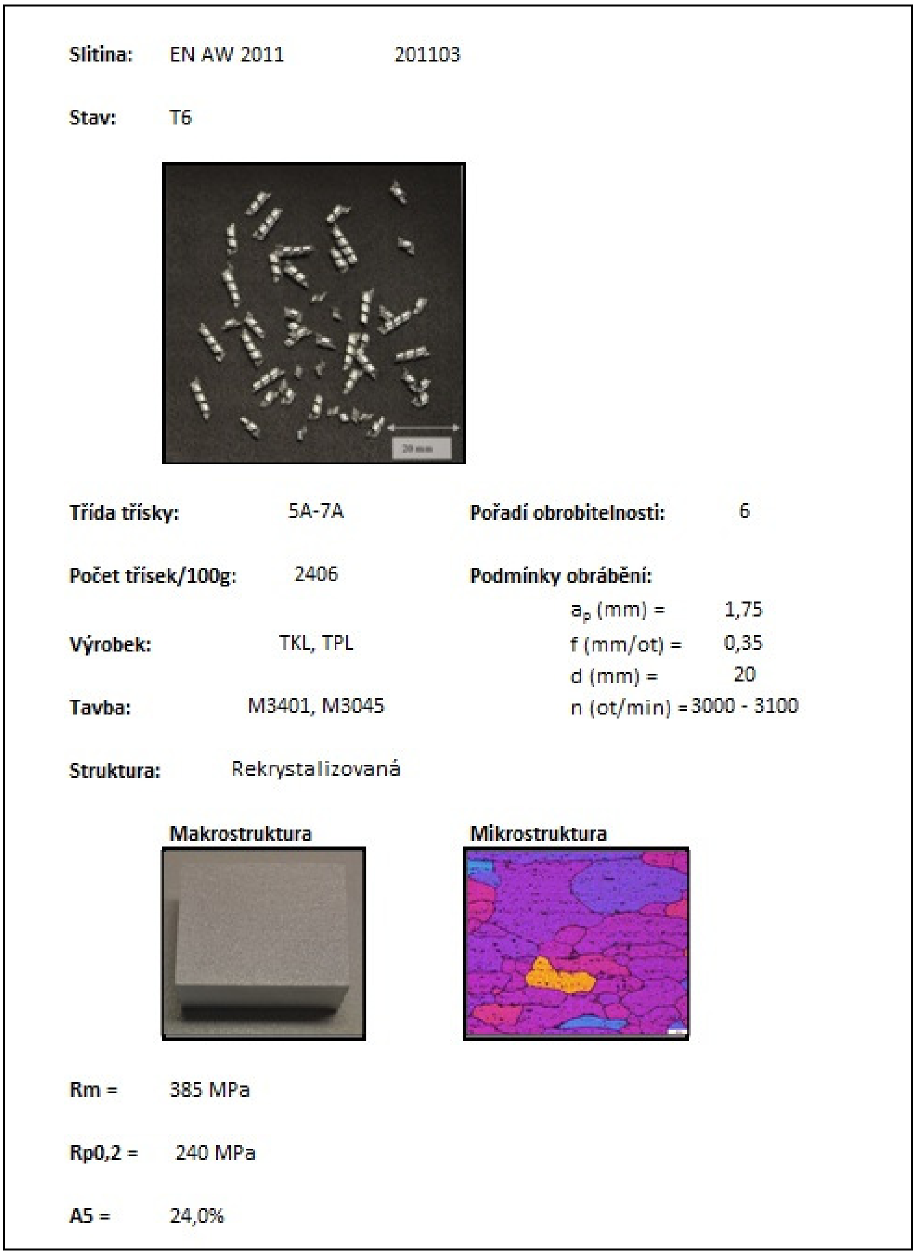

Fig. 10. **Example of the alloy classification list (datasheet)**

Conclusions

Practical experience in processing of anything in techniques for engineering students is very useful and important, too. Such experiences have often meant for them increase of their opportunities and chances in the labor market and also to try something like that in the course of their studies. Unfortunately, the current funding of technical disciplines at public universities generally does not allow students to complete various exercises at the school itself, and especially to the extent that would be more beneficial (all of the above activities require instrumentation, material and energy security, and it is obviously quite costly). At present practical experience in teaching, therefore, students can get only in limited quantities, and just like opportunities are unique. Therefore, it is essential that universities directly seek similar opportunities, see above, that students have better access to practical experience and to the verification of theoretical knowledge from studies. This experience helps better orient students in further addressing other technical problems and situations.

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