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Motivation Tool Raising Productivity of Labor

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Abstract

In the paper we deal with creation of motivation programs in the company and information obtaining for motivation programs from questionnaire research of motivation factors and motivation advantages for the employees. Motivation is tool that increases performance of the employees and it contributes to the increasing of the whole firm's performance. According research we found out that in the chosen firm financial rewarding is most important motivation factor and therefore motivation program must be built in this direction. But preparation of motivation program consists from several steps that must be accepted during their creation and in the presented paper we will deals mainly with mentioned.

Key words: *motivation, motivation program, motivation factor*

1. Introduction

Motivation presents a tool for increasing of the employees' performance in the company that must be orientated to the increasing of the activities that create profit [Teplická, 2010a]. Motivation of the employees must result from the goal of the company and their orientation. Motivation of workers begins with motivation of managers. Base of good motivation can be qualitative motivation system with direct relation to the financial contribution of the activity. Motivation factors that influence behavior of the employees and their attitude to motivation are important part of motivation system, therefore there is necessary to know individual motivation factors of every employee. Motivation through financial rewarding is not first and foremost in the companies and emphasis is given evenly to the not financial motivation factors as for example possibility of promotion, social relations at the working place, public approval, possibility to decide individually and to manage working time of the employee by himself [Hitka, 2002]. Motivation is a tool for development of human potential in the company.

2. Motivation development

Motivation programs present tool for motivation development and they lead to the increasing of the work productivity and performance of employees. Preparation of motivation programs in the companies presents long term systematic process, through which goals of the company will be achieved. During creation of motivation programs there is necessary to know principle of motivation and its importance for increasing of human potential value. Various authors dealt with motivation and some of them presented in their theories important position of the individual motivation factors, Tab. 1 [Koubek, 1998].

Tab. 1. Analysis of motivation factors for individual motivation theories

Herzberg two phases theory	Maslow hierarchy of the needs	Alderfer theory ERG- theory of three factors	McClelland theory of success
Success Work Responsibility Process and growth	Necessity of self realization	Necessity of promotion (self approval, self realization)	Necessity of success (goal achievement)
Approval	Necessity of approval	Necessity of harmonic relations	Necessity of power (necessity to manage other persons – managerial positions)
Control Interpersonal relations	Social needs	Existence needs	Necessity of fellowship
Certainty of work System of organization management	Necessity of security Certainties		
Wage Working conditions	Physiological needs		

As we can see from the individual theories of motivation, every one prefers different values; every one of them is orientated to the satisfaction of different needs. According these theories we can search motivation of employees in the company through needs that have been dealt by famous authors of motivation theories. But whole process of motivation demands observance of certain process. First of all there must be raising motive (internal incentive), then characteristics of the necessity that has to be satisfied, necessity demands determination of concrete goal for the need providing, consequently activity and achievement of the determined goal. Before consideration of the way of employees motivation we should realize small research by the way of questionnaire with aim to find out their priorities and to know how to prepare proper motivation program that could include individual groups of employees and their needs. We should orientate to the areas that have been demarcated to the motivation program. We prepared questionnaire according questions in Table 2, by which we wanted to find out how employees perceive motivation, what is important for them, and what is not important, and what motivation theory would they choice during creation of motivation program (Tab. 2).

Tab. 2. Questions for evaluation of motivation in question form

1	Do you know motivation system in Your company?	21	Is there mutual tolerance in working post and willingness from the side of colleagues?
2	Do you know system of rewarding in Your company?	22	How do You evaluate communication with Your superior?
3	What elements of rewarding are important for You?	23	Do You obtain approval from superior for properly done work?
4	What forms of wage do you obtain?	24	Is Your superior interesting about Your opinion?
5	Does volume of Your wage have influence to staying in the labor relation?	25	Does Your employer organize social event for You?
6	Is Your wage sufficient for covering of Your basic needs?	26	Do You have some plans how to improve in work?
7	Is development of the company reflecting also in Your wage?	27	What form of reward would be pleasant for You for extraordinary results?
8	Do you know what employees´ advantages can Your company provide for you?	28	Are You satisfied with moment working position?
9	What employees´ advantages would You invite in Your company?	29	Does Your company offer possibility of further free education?
10	Is working certainty in the company important for You?	30	Are You trying to achieve approval or promotion in the company?
11	What relation do you have to Your company?	31	Are You satisfied with your working time?

12	Is Your work interesting?	32	Is Your performance in accord with Your effort?
13	Are You satisfied with informing about activity of You company?	33	Do You think you can improve in work against previous year?
14	Are You satisfied with quality of working environment?	34	Do You feel limited in the work?
15	Are You satisfied with equipment of Your working post?	35	Do You something extra with aim to achieve success or approval?
16	Is there possibility in Your company for education?	36	Do You need permanent stress from superior to increase Your performance?
17	Do You have possibility of career promotion in the company?	37	Do You sometimes neglect your working obligations at the expense of personal interests?
18	How do You evaluate relation to the superior?	38	Do You have possibility to decide or altogether decide on the company?
19	Are there existing conflicts in Your working post?	39	Do You know how to manage Your working time with aim to fill all tasks?
20	Can You ask Your colleagues for help?	40	Do You have possibility to develop creativity in Your company?

3. Procedure of preparation motivation programs

Motivation programs and their precise preparation can lead to the increasing of the employees´ working productivity. Whole philosophy of improving should be carrying in the sense of improvement and increasing of working productivity and performance of employees. Creation of motivation programs is dependent on the workers education, working position and job title of the employees, climate of the company, economical possibilities of the company, presently using motivation programs and management of the company. Theory and practice of management in last time is orientated to the area of companies' management to the conception of integrated management [Hitka, 2002].

Preparation of motivation programs can be provided through workers of the company that means through internal employees, but there can be risk to enforce interests of certain group of employees. Second possibility of motivation program preparation is elaboration by external advisory organization or agency that could provide good expert level of motivation program elaboration, but risk is long term process of the knowledge of company and its employees, as well as program financing. Third possibility can be cooperation of the company and external advisory agency that could bring high effect of expert preparation, remove risk of lost time of the project and decrease cost for the program financing. Achievement of the demanded level of workers motivation with emphasis to the increasing of working productivity presents supporting element of the motivation program [Teplická, 2010b]. Optimal motivation program should to be elaborated according goals and possibilities of the company and it should lead to the permanent improving of the employees´ performance. Company should consider with financial and non financial stimulus, but also with specific forms of motivation factors that will reflect in the financial component of the firm's costs.

Preparation of motivation programs demands process according certain algorithm of steps:

1. Analysis of motivation structure, motivation profile of workers and evaluation of character of their satisfaction.
2. Determination of short term and perspective goals of motivation program that means determination of areas, to which influence of motivation program must be primarily orientated.
3. Processing of present performance characteristics in the limited area and determination of its demanded level.
4. Limitation of the potential stimulation tools in relation to the supposed orientation of the motivation program.
5. Choice of concrete forms and processes of working behavior stimulation and determination of concrete conditions for their applying.

4. Results of motivation factors in the firm

We can prepare motivation programs in the firm after evaluation of question forms that they consist of some questions with theme motivation, motivation factors, advantages and disadvantages of motivation in the firm and other [Teplická, 2010a]. With aim to prepare qualitative motivation program we need to find out according questionnaire what motivation factors influence workers of the company most of all. Results of questionnaire research in the chosen company are as follows (Tab. 3).

Tab. 3. Weighted average of motivation factors in the company

Motivation factors	Most important	Very important	Important	Not important	Weighted average
Financial rewarding	23	5	2	0	**3.70**
Certainty to have work	18	12	0	0	**3.60**
Education and personal growth	3	7	15	5	2.27
Social care	4	16	10	0	2.80
Family life and leisure time	6	12	12	0	2.80
Approval	2	5	23	0	2.30
Stress	0	4	10	16	1.60
Independence	2	6	10	12	1.93
Prestige	2	5	7	16	1.77
Better superior	4	14	11	1	2.70
Atmosphere in working post	6	13	11	0	2.83
Righteous rewarding	21	5	4	0	**3.57**
Image of company	2	10	8	10	2.13
Sufficient information about activities in the company	3	12	10	5	2.43
Better work organization	5	13	11	1	2.73
Ecology of company	1	14	15	0	2.53
Occupational advantages	9	9	12	0	2.90
Working conditions	6	12	12	0	2.80

From the mentioned results we can see that **financial means** present for the chosen respondents most important motivation factor. It is not very gratifying for the company, since employees are motivated primarily through financial form of reward. **Certainty to have work** is second most important factor that motivates employees, which is understandable mainly for family orientated employees. Next element in spectrum of motivation factors presents righteous rewarding for performance and occupational advantages. Atmosphere at working post influences sufficiently work of employees. Consequent factor is social care, family life and leisure time and working conditions. Sequence of further motivation factors is in the following rank: better organization of work, better superior, ecology of company, sufficient information about activities in the company and approval. It is interesting that motivation factor – education and personal growth fit in 14th place, it is very important for employees at leading positions, therefore it is not motivating factor for employees in workers´ professions. Respondents had given minimal importance to the motivation factors, as for example: image of company, independence, prestige and stress.

These results for motivation factors in the selected firm are very orientated on financial aspect and just this information is very important for preparation of motivation program in the firm, and by the preparation of motivation program we can use Herzberg or Alderfer theory of motivation how to prepare aims of motivation program. Results of this analysis show that employees in the selected firm prefer financial motivation. Therefore we will analyze situation, which employee's amenities are interesting for employees. In Table 4 we designed some employee's amenities that are connecting with financial aspect and financial motivation.

Tab. 4. Research of occupational advantages from chosen respondents

Type of amenities	Number of respondents YES	Number of respondents NO
Catering	**30**	0
Loans per housing	0	**30**
Reward for blood donor	7	**23**
Social subsidiary	17	13
Cultural events	14	16
Sports events	16	14
Recreation	25	5
Health care	27	3
Care for retirees	10	**20**

From this research results we can evaluate that employee's amenities are not interesting in this company as financial motivation besides catering, recreation, health care. The employees prefer financial motivation in loan, fee or increasing wage. Advantages that are supported by financial resources are not interesting for employees. The employees do not have interest for some advantages for example loans per housing, reward for blood donor or care for retirees.

5. Conclusion

For the aim of motivation program creation we came to the results that speak about most important factor for employees of the chosen company – basic financial reward. Second most important form is variable element, then occupational advantages and non financial rewards. It is important that company would combine all elements of the wage and by this way to achieve better interest from the side of employees. Financial motivation from this view becomes most preferred form of employees´ motivation and therefore motivation program must be orientated mainly to this area. Motivation trainings are part of the motivation program and tool for increasing of qualification growth of the employees [(Mura, 2012].

Motivation program contributes to the satisfaction of employees and their stability in company, it removes fluctuation and dissatisfaction. Motivation program must bring satisfaction of worker and it must reflect also in his working tasks, benefits, wage and living balance of worker [Rani, Kamala-nabha, Selvarani, 2011]. Motivation programs are necessary to create in the companies, where there is important to manage motivation of workers systematically and as a long term process. Motivation factors must be positively balanced with aim to be stimulus for working activities of employees and to present satisfaction of their needs and demands. In case motivation of workers and their performance is growing, we can speak also about increasing of working productivity if we consider with stable number of employees, and at the same time increasing of performance will reflect in higher sales, and working productivity will also increase. During increasing of sales there should to be considered also with growth of costs for creation of motivation program and its providing, which will reflect in the economical result of the company.

References

[1] Armstrong, M. (1999): Personální management. Prague: Grada Publishing, 1999. ISBN 80-7169-614-5

[2] Bleicher, K. (1991): Das Konzept Integriertes Management. Campus Verlag, Frankfurt - New York 1991, p. 470

[3] Hitka, M. (2002): Tvorba motivačných programov vo výrobných podnikoch s využitím viackriteriálnych štatistických metód. MVK CO-MAT-TECH Trnava, 2002, p. 61-64, ISBN 80-227-1768-1
[4] Koubek, J. (1998): Řízení lidských zdrojů. Prague: Management Press 1998. ISBN 80-7261-168-3
[5] Mura, L. (2012): Performance of Human Resource Management in an Internationally Operating Company. In: Serbijan Journal of Management, Technical faculty at Bor, Serbia, Vol. 7, No. 1/2012, p.115-129. ISSN 1452-4864
[6] Rani, Sakthivel, Kamalanabhan, Selvarani (2011): Work/life balance reflections on employee satisfaction. In: Serbijan Journal of Management, Technical faculty at Bor, Serbia, Vol. 6, No. 1/2011, p.85-96. ISSN 1452-4864
[7] Teplická, K. (2010a): Ako pomáha motivácia zvyšovať zisk**.** In: Zisk, No. 3, 2010, p. 12-14. ISSN 1337-9151
[8] Teplická, K. (2010b): Zlepšovacie návrhy ako prostriedok rozvoja ľudského kapitálu. In: Hodnota duševnej práce pre organizáciu a spoločnosť. Determinanty, kritériá a hodnotenie duševnej práce. Zborník vedeckých prác. Košice : UPJŠ, 2010, p. 403-409. ISBN 978-80-7097-847-4

Trends in Technology of 3D Integration

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Abstract

In the article the trends of interconnection technologies in electronics and evolution of 3D integration are analyzed. The applications of low temperature co-fired ceramics are described due to its high potential in the field of 3D integration. Described technologies are supported by the specific applications from the field of sensor and microsystem applications, which were realized on Department of Technologies in Electronics.

Key words: *3D integration, LTCC (Low Temperature Cofired Ceramic), HTCC (High Temperature Cofired Ceramic)*

1. Trends in mounting and interconnection technologies

Today's assembly standards are oriented to multilayer printed circuit boards, which can be considerred as suitable solution for the most of electronic systems. Electronic systems miniaturization has led to application of film technologies with the possibility of semiconductor technologies utilization, which is the basis of hybrid 2D and 3D structures. Development of thick film technology was conditioned by its flexibility, simplicity and low initial investment. In line with the development of new thick film materials and with the improving of thick film technologies is now changing the nature of their use in various fields of electronics. Integration level of Electronic systems is significantly influenced by electronic components, manufacturing process of reconnection nets realized by following techniques:

- high temperature (HTCC – High Temperature Cofired Ceramic) technology which provide better resolution than classic thick film technology because reconnecting nets can be printed to various substrates with vias;
- low temperature (LTCC – Low Temperature Cofired Ceramic) technology using low temperature cofired ceramics.

Qualitative leap to higher integration was achieved by multi-chip modules (MCM) amplified by using chip-scale package (CSP), flip-chip technology (FC), tape automated bonding (TAB), ball grid array (BGA). Multi-chip modules have some common features. They contain many reconnected signal layers, which are intended for mounting of bare chips optionally other components to very dense network of soldering pads on the top substrate and connected to one package. MCM can be divided according to manufacturing technology into three basic groups: MCM-C (ceramic), MCM-D (deposited) and MCM-L (laminated).

In terms of production, use of microelectronic technologies can be divided into three basic areas:

• semiconductor devices,
• passives and accessories,
• assembly, interconnection and packaging.

Another way to higher integration is the development of a new generation of passive components that are integrated into the volume of the substrate. Technology trends head toward the 3D system integration as future perspective in electronics (Fig. 1). Modern 3D system integration technologies have as its objective increase the complexity, extend functionality, improve the reliability and increase cost efficiency at all level of 3D manufacturing technologies.

Essentially it is necessary to focus to basic and applied research in the subsequent order:
- design,
- new materials, technologies,
- reliability,
- testing and the impact of areas of use.

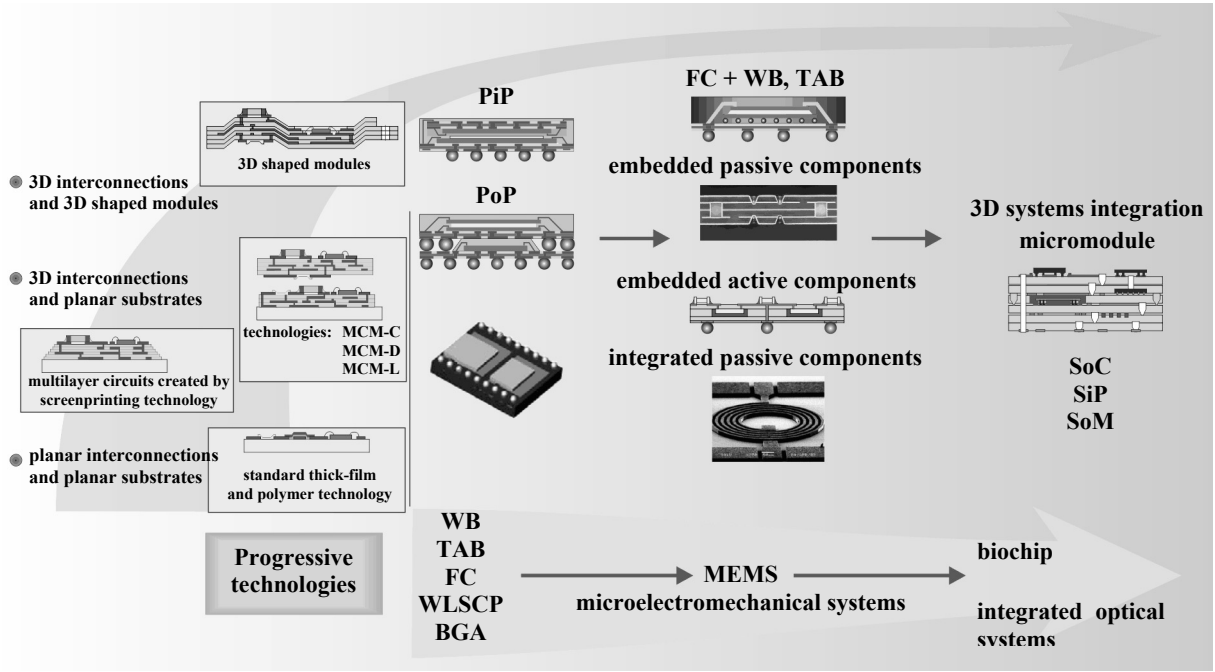

Fig. 1. Trends in 3D integration technologies [1]

On the basis of previously stated there is demand on advanced packaging technologies. Large numbers of technological solutions are already available such as 3D stacking (chip on wafer, chip-on-chip), technology package on package (PoP), package in package (PiP), and other technologies that are under development. Higher priority has constructional and reconnection technologies, e.g. Chip-Stacking (>10 layers) or low temperature fine pitch bonding. It is essential that all processes have to be capable of industrial tests and must be very reliable [7].

Package on Package

Package on package is technological solution in which the tested package is placed on the other package during mounting process and it is bonded by solder balls (Fig. 2).

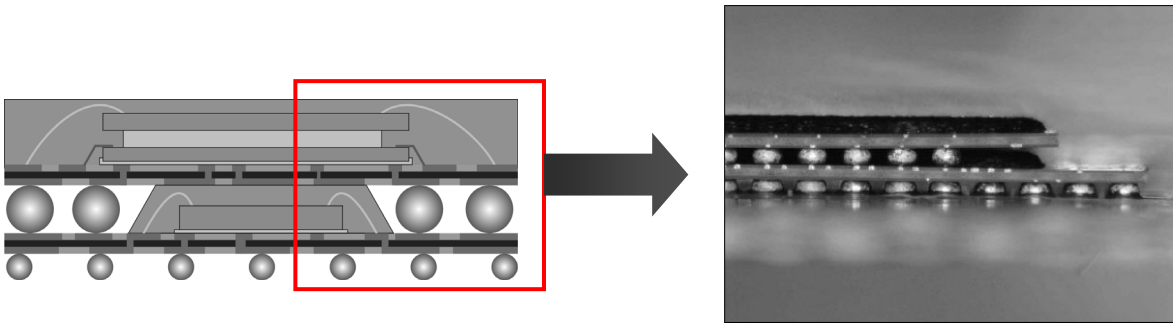

Fig. 2. Technology of vertical placement of packages - PoP [8]

Package in Package

Other type of 3D packaging is package in package. In this solution the upper package is not connected to bottom package by solder balls such as PoP but very thin LGA packages are used and bonded by wire (Fig. 3).

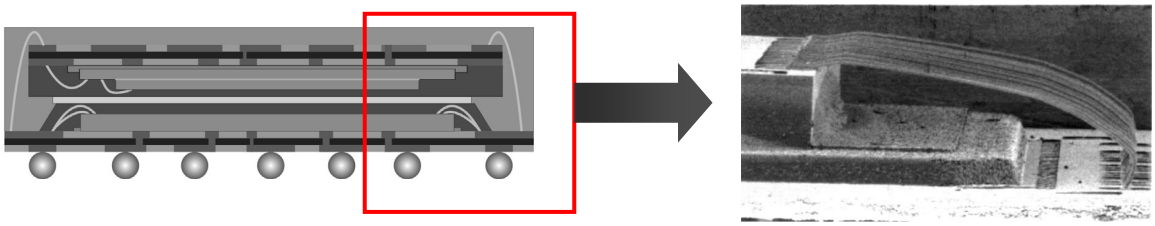

Fig. 3. Technology of vertical placement of packages - PiP [8]

The main concepts of 3D system integration are SoC (System on Chip), SiP (System in Package) and SoM (System on Module).

- System on Chip (SoC) is technology of integration that integrates all blocks of system into a single chip (Fig. 4). For example, the SoC device for sound detection may include audio receiver, analog-to-digital converter, microprocessor, memory and required input/output functions. Concept of System on Chip has been developed in the last decade and is affected by significant progress in the design technologies and in manufacturing of semiconductor technologies.

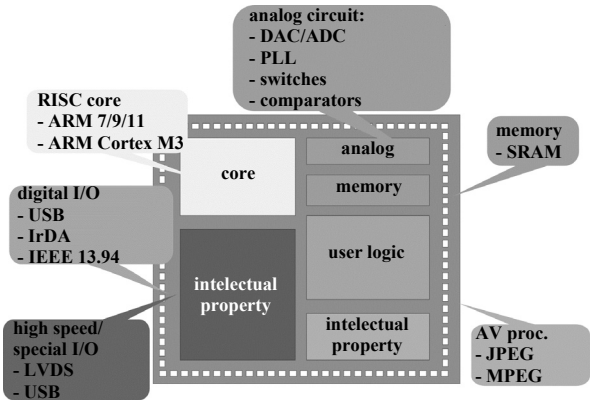

Fig. 4. System on Chip [2]

- Basic principle of SiP is the integration of one or more chips, passive or special components, input of medium (in case of microsystems) etc., into a single package. Package with integrated components corresponds to standard semiconductor packaging (Fig. 5). Functional parts can be placed vertically or horizontally on the ceramic, polymer or metal substrates. Bonds are usually formed by wire bonding or Flip Chip Technology. Fig. 6 shows basic distinguish of SiP technology.

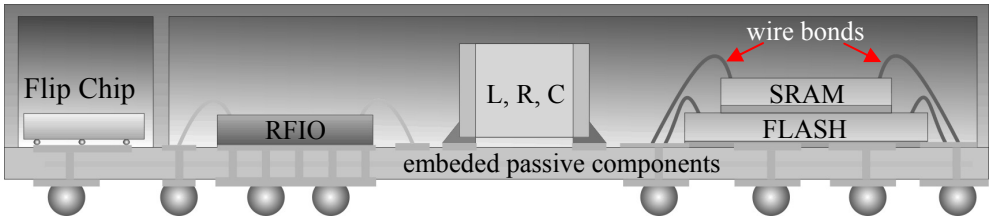

Fig. 5. Cross-section of SiP [3]

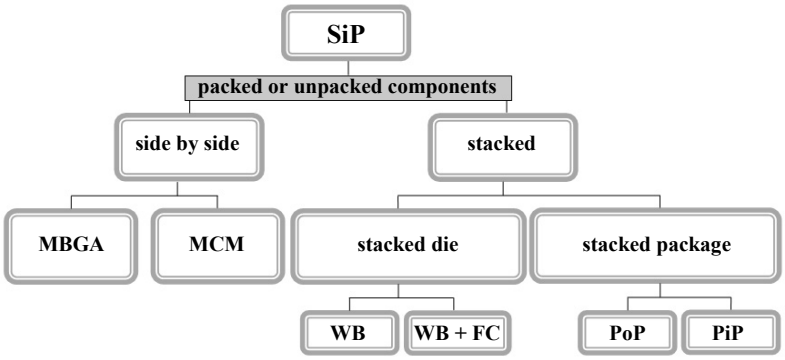

Fig. 6. Distinguish of SiP technologies [3]

- System on Module provides configuration of system where all main functions are integrated into single substrate. The most common application of SoM is single board computer so called Computer on Module (Fig. 7).

Fig. 7. Application of System on Module for informational technologies [9]

Utilization of System on Module has following advantages: faster deployment on the market, cost saving, smaller risks during fabrication, service life extension and smaller dimensions.

Example of SoM application is 3D integration of mobile minimachine control electronics using LTCC-HTCC heterostructure realized on Department of Technologies in Electronics at Technical University of Košice. Heterostructure is based on different thermal conductivity of substrates with possibility of heat dissipation by HTCC substrate [6]. Figure 6 shows location of heat source on the LTCC structure (a) and embedded into surface cavity of LTCC and placed on HTCC substrate (b).

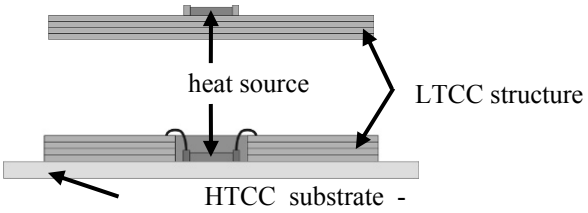

Fig. 8. Location of heat sources [6]

Temperature dependence of the heat sources on power for various HTCC substrates is shown on Fig. 9. From the courses can be concluded that thermal conductivity of HTCC substrate has significant influence to increase of temperature on heat source.

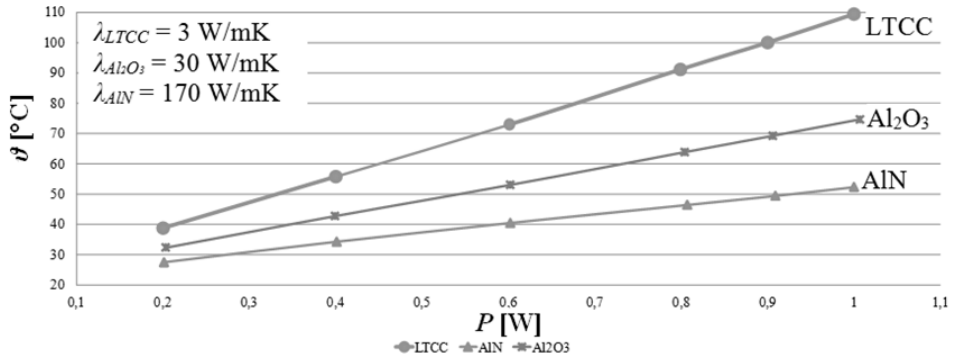

Fig. 9. Temperature dependence of the heat sources on power

Figure 10 shows block diagram of control electronic and consist of - interconnection part with power components (motor driver and power stabilizer), microprocessor block and sensor block.

Interconnection part consists of LTCC structure – HTCC substrate heterostructure. On the interconnection part the power source with stabilizer and motor driver (Fig. 10) are integrated and they are located on HTCC substrate via surface cavities of LTCC structure. The heat dissipation from power components and mechanical assembly to chassis is provided by HTCC substrate. On four-layer LTCC structure with shaped part the functional blocks according Fig. 10b are located.

A complex and very thin components together with already mentioned technologies allow flexible development of integration techniques. This will probably lead to combination of SoC and SiP in the future, and it can be characterized as Heterogeneous Integration. Application of appropriate method in 3D integration of systems is also determined by the other aspects. An important role is played by the production cost, possibilities of testing, reliability limits, components availability, possibility of heat dissipation and interfaces (physical and information-technical).

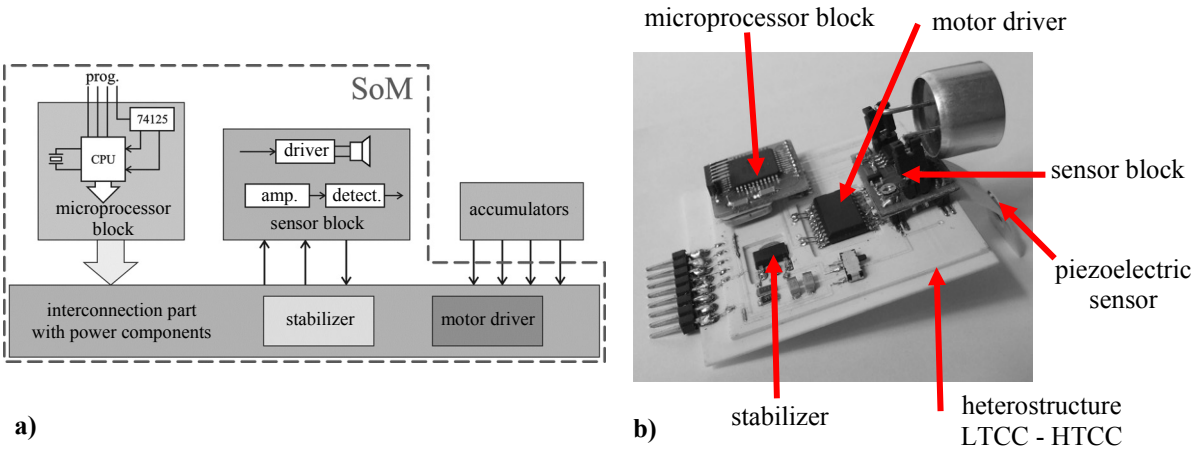

Fig. 10. a) block diagram of control electronic of mobile minimachine, b) practical realization in SoM assembly [4]

- LTCC technology has all the prerequisites for application in 3D systems. LTCC has good mechanical and electrical properties. Currently it is applied e.g. in multichip modules and sensors. The complex structure by cutting, lamination of multi layers (where the thick films of conductive, resistive, dielectric or other patterns are created) and firing can be created (Fig. 11).

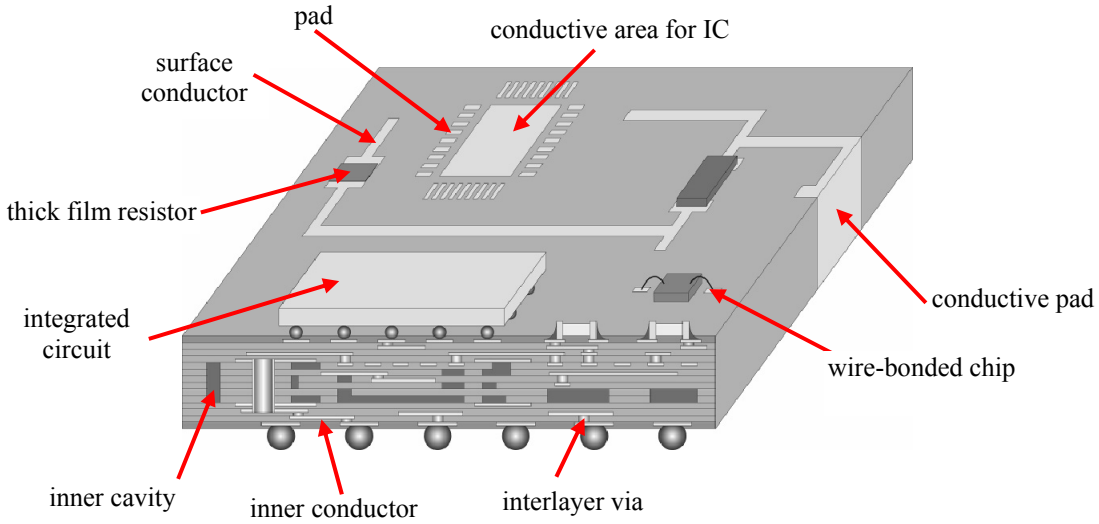

Fig. 11. Multilayer structure based on LTCC [10]

Another possibility of the LTCC is shaping of ceramics to complex shapes. Shaping should be required due to the system functionality or easier connection of system to structure with more complex shape.

Technology of shaping the LTCC to complex shapes consist of following steps: cutting of LTCC, screenprinting of conductive layers, stacking of layers, planar lamination, 3D lamination using shaping form, firing of samples (Fig. 12).

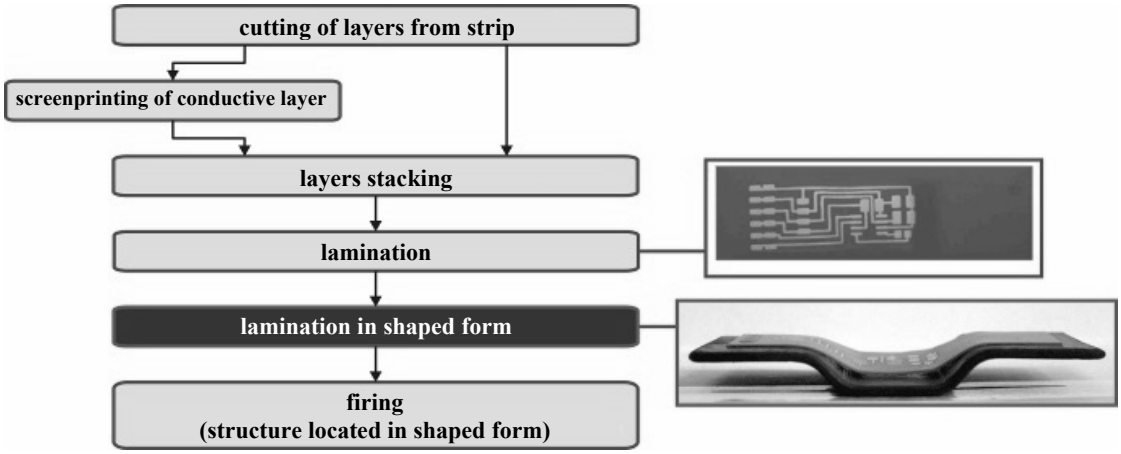

Fig. 12. Block diagram of multilayer shaped sample realization [5]

Described technique has been verified on 3D shaped module with integrated pressure sensor for medical purposes. LTCC was used for membrane embedded into metal housing (Fig. 13a) and also for creation of membrane housing (Fig. 13b) what creates single unit with possibility of evaluation electronics integration.

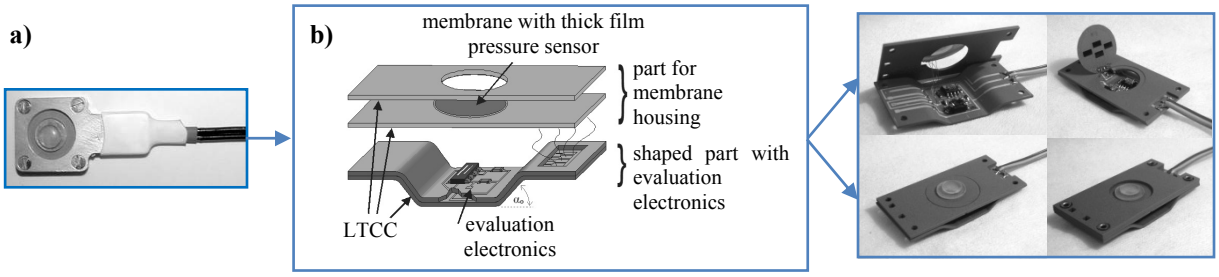

Fig. 13. Solution of pressure sensor: a) in metal housing, b) in ceramics housing

2. Conclusion

Application of appropriate technology of 3D integration of systems is determined by various aspects. Important aspects are cost of production, possibilities of testing, limits of testing, availability of components, heat dissipation and existence of interfaces such as physical and information-technical. (Project VEGA No. 1/0074/15)

References

[1] Slosarčík S., Kardoš S., Jurčišin M.: Výrobné procesy v elektronike 2, ISBN 978-80-8126-096-4, Vienala, 2014
[2] Fujitsu Ltd., Semiconductor Solutions, Online: http://www.fujitsu.com/emea/services/micro-electronics
[3] Nunn W., Soido D.: System In Package (SiP) and Stacked Package Solutions, IMAPS, 2007

[4] Slosarčík S., Bauer R., Gmiterko A., Cabúk P., Jurčišin M.: Aplikácia nízkoteplotne vypaľovanej keramiky v 3D integrácii systémov, Chemické listy, Vol. 105, No. S, 2011, p. 571-573. ISSN 0009-2770
[5] Slosarčík S., Vehec I., Gmiterko A., Cabúk P., Jurčišin M.: Technology and application of 3D shaped LTCC modules for pressure sensors and microsystems, IMAPS, Journal of Microelectronics and Electronic Packaging, Vol. 6, No. 3, 2009, p. 158-163. ISSN 1551-4897
[6] Jurčišin M., Slosarčík S., Kardoš S.: Design of Heat dissipation from 3D LTCC structure based on hetrostructure, ADEPT 2014. ISBN 978-80-554-0881-1
[7] Lang K.L.: Hochentwickelte Integrations- und Packagingtechnologien für Miniaturisierte Systeme, MikroSystemTechnik 2007. ISBN 978-380-07306-12
[8] Töpper M. et al.: WLCSP Technology Direction, Advancing Microelectronics, Vol. 33, No. 1, 2006, p. 8-11
[9] Atrenta: SoC Realization 2011, Online: http://www.atrenta.com/Atrenta-SoC-Realization.pdf
[10] LTCC Process Steps, www.ltcc.de

Effective Teaching of English Technical Vocabulary

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Abstract

This paper discusses the issue of effective teaching of technical English vocabulary to students of engineering and technology as a means of promoting student learning. Modern technologies require learning a wide range of vocabulary in a variety of engineering fields, and how effective the learning process is largely depends upon the effective mastery of technical vocabulary. It is also associated with the effective choice of appropriate textbooks, supplementary course materials and strategies that can be adopted in teaching technical English to enable students to deal with specific technical tasks and challenges in professional practice.

Key words: *English technical vocabulary-- effective teaching-- teacher's response*

Introduction

Modern technologies of today have increased the need for teaching a wide range of new vocabulary to students of technology and engineering programmes covering a variety of specific fields in technical education. Mastering technical vocabulary or specialized vocabulary in learning a certain field of knowledge is very crucial for learners in order to develop the ability to read and comprehend technical texts in English well. If you are an ESP teacher or lecturer it is important to carefully consider what kind of strategies you will use to teach technical terms for your students and how you will implement those strategies in your class. Below, the focus is first on the importance of teaching technical English vocabulary in engineering colleges, and then a brief description of the problem of effective teaching technical English is presented followed by a presentation of some of the processes in word formation in technical terms. Finally, the strategies that can be adopted in teaching technical English vocabulary in engineering colleges are briefly discussed.

Technical English Vocabulary

Learning technical English is associated with conscious acquiring, consolidation as well as implementation of technical vocabulary knowledge and skills. Effective teaching challenges English teachers in technical schools and engineering education institutions to adopt strategies and apply methods that will help their students master and effectively use the obtained knowledge in a variety of engineering fields taught at their schools. Since vocabulary is the key to developing practical understanding of engineering areas, teachers are now required to update the kinds and amount of technical vocabulary necessary for students to effectively develop their technical vocabulary as well as their knowledge of specific technical jargon in order to correctly define and use specific terminology related to technology with increasing confidence and effectiveness. What follows here is an attempt to

describe how we can enable the mastery of engineering concepts and processes through teaching English technical vocabulary to the students of engineering and technology.

Technical English vocabulary is not part of the learner's general cognitive development. Teaching of technical English is associated with conscious, formal learning of specific competences that forces students to choose the right words and apply the relevant rules; it also forms an important aspect of study to enhance the spoken and written English capability.

At the Technical University of Košice specialized technical English courses have been integrated as compulsory subjects into the curriculum of all engineering courses of studies.

We expect that students enrolling in our university are on level B1 at the beginning of their studies (based on the national requirements for school leaving exam), but in fact a lot of students tend to be below that level. We even have a large number of students who have never or only for a very short period of time (2 years or less) learned English at their primary and secondary schools. These heterogeneous groups require a special approach and consequently a more detailed insight development of the course materials as well as effective choice of appropriate textbooks, supplementary course materials and strategies that can be adopted in teaching technical English to enable these students to deal with specific technical tasks and challenges in professional practice.

To deal with this situation, we have introduced a number of measures:

- Placement tests
- One or two semester preparatory courses (optional subjects) in English before taking compulsory courses of technical English
- Self-assessment tests

This kind of testing serves both as a testing tool applied in development and accomplishment of curricula, requirements placed on learners, improvement of effective language teaching methods as well as a tool for learners' self-monitoring of their progress. Based on the latest experience in this field it can be stated that the importance of self-assessment goes beyond learners and teachers and could influence in a certain way the performance of an institution as a whole. The learners' benefits from this process as follows:

- reflection (their advancement and the results achieved),
- motivation (an important stimulus for further development),
- support (highlights their what their problems are and outlines the tasks that have to be carried out).

The teachers' benefits can be summarized as follows:

- evaluation,
- monitoring,
- analysing of needs.

In the needs assessment process, the teacher does his/her best to find out information about the needs and wants of the learners, and the context in which the learning will take place.

Emphasizing the development of reading skills in students or promoting the development of spoken skills depends to a great extent on students' needs to be successful in their field of work. Teaching of conversational skills to engineering students, especially using the Internet, concentrates more on the language used in context than on teaching grammar and language structures. The Internet is a wonderful resource that helps teachers enrich their lessons through providing authentic and up-to-date materials, interactive exercises, quizzes etc. customized for any level of students. From the beginner to advanced level, students will be able to practise their conversational skills using the Internet as an effective and efficient tool that provides them global access to engineering education and the variety of appropriate information sources depending on their needs.

The Internet allows students to research a particular topic; they can prepare and share presentations either individually, in pairs or in small groups. Presentation skills allow students to practice vocabulary related to their field of study in addition to giving them a chance to do relevant

research. If necessary, the necessary vocabulary and structures may be pre-taught to students to help them understand English texts properly. Teachers can them either one or more relevant websites, or allow them to search for suitable websites themselves via search engines.

Teaching Internet terminology

It is also an important task for teachers: how to say emails address correctly (e.g., @ is read as 'at'), how to read, understand and use English language websites. English articles on science and technology on English and American websites, or published in magazines and newspapers can be used as teaching materials providing students with plenty of authentic learning opportunities that stimulate their interest and helps them create effective learning experiences.

Using the Internet learners become independent, they develop their creativity and autonomy being motivated to use and develop skills such as analysing, synthesizing and evaluating, collecting, organizing and interpreting the language of the information to be put to use thus providing students with the necessary knowledge base and experiential learning required. In this process, teachers play a role of facilitators giving support, monitoring progress and assessing results, as well as providing guidance on what is important in the effective technical vocabulary study.

Teacher's response and guidance

Teacher's response and guidance during the students' language acquisition process in general being a formative assessment of their achievements is an efficient means to inform them of the level of their skills and the quality of their work. Teachers should respond regularly to the students' work and their response should be presented in a pedagogical manner to facilitate students' understanding and to keep them interested. Responses should focus on a selection of aspects of the students' work and make students think about, reflect on and evaluate their own learning. Moreover, teachers' response should be given based on the work they did completing their assignments and in accordance with the requirements tailored for the particular English language course and assessment criteria appropriate for the level being assessed. As long as students are aware of the requirements and criteria, it will help enhance their motivation for work and encourage them to actively achieve their goals.

Conclusion

Offering engineering students the opportunity to learn and master English technical vocabulary from the very basics through the most advance, to develop adequate and comprehensive language skills is becoming an ever increasing necessity both in the classroom of today for a wide range of tasks and in everyday life in modern times as they will need these skills in their studies as well as in their future profession in order for them to have a viable chance at a good job. In order to effectively teach English technical vocabulary to engineering students, compulsory English language learning programmes have been incorporated in their studies. The aim and focus of every language programme should be the development of the language skills and learning of the vocabulary that engineering students will need in their future profession as engineers. As engineers they will communicate both orally and in writing for various purposes and in different contexts and situations, the language programme should include activities closely related to and connected with authentic, real life situations as much possible. The use of authentic and motivating English learning material (e.g. newspaper and magazine articles, the Internet) in the language acquisition offers students an opportunity to acquire and develop language competences their future professional life.

References

[1] Anthony, L.: English for Specific Purposes: What does it mean? Why is it different?, 1997, http: //www.antlab.sci.waseda.ac.jp/abstracts/ESParticle.html
[2] Bell, D.: Help! I've been asked to teach a class on ESP! IATEFL Voices 169, 2002, http: //www.esp-world.com
[3] Dudley-Evans, T.: English for Specific Purposes. In: The Cambridge Guide to TESOL, Cambridge University Press, 2001
[4] Dudley-Evans, T.: Developments in English for Specific Purposes: A Multidisciplinary Approach, Cambridge University Press, 1998
[5] Hutchinson, T. and Waters, A.: English for Specific Purposes. Cambridge: Cambridge University Press, 2000
[6] Jordan, R.R.: English for Academic Purposes: A Guide and Resource Book for Teachers. Cambridge: Cambridge University Press, 1997
[7] http://www.usingenglish.com/articles/how-to-teach-english-for-engineers.html#UhFm5gbFME 53B2St.99

Quality of Environment and its Quantitative Determination in Mechanical Engineering

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Abstract

A mathematical method is applied to the solution of this problem. The individual factors of environmental and economic character have been expressed before, in the other publications, by means of different equations having universal validity. The progress in this field is the quantitative expression of the quality of environment in the local level. The presented method is applied in the field of mechanical engineering. Each of summarized criterions is represented by its graphical form. The final results can be presented in the percentual and monetary form, too. An application in the automotive industry closes the paper.

Key words: *optimal production volume, environmental and economic criterions, quantitative expression of the quality of environment, mathematical modeling, graphical presentation, automotive industry*

Introduction

Operational Program (OP) – Quality of Environment [1,2] is a research program, what has been approved by the European Commission for the Slovak Republic. About 4,3 billion € will be disposable from the European Structural and Capital Funds for this OP during the years 2014-2020, including the Slovakian co-financing. The Slovak Ministry of Environment will be co-operate in this research program with lot of institutes as

- Slovak Agency of Environment,
- Department of Home Affairs,
- Slovak Agency for Innovations and Energy, and some others.

This OP has an integral characteristic, because it supports activities concentrated to

- waste management,
- water management,
- preservation of air quality standards and its improvement,
- decontamination of environmental ballasts, and nature preservation.

Mechanical engineering represents in the Slovak economy its significant part. It is a key innovative industry and, as such, any European industrial policy must consider mechanical engineering as a strategic sector [3]. The question is – what an influences has mechanical engineering on the quality of environment? There are a lot of methods an approaches, how this problem express, for example exactly, or as a declaration. It would be suitable to find some method for the quantitative

expression of the quality of environment, as one of the results of mechanical engineering production processes. A lot of analytical methods how to solve this problem are suitable [4]. One of them is described in this paper [5,6].

The basic environmental and economic factors and their expression

According to the formulas presented in [5] the most important ones are the following:

$$K_1(x) = C_1/x \tag{1}$$

where C_1 is a disposable quantity of natural capital during a year, for production of **x** products in a mechanical engineering works.

The total costs for environment protection, signified as $K_2(x)$, is defined as

$$K_2(x) = C_2 \,.\, x + INV + SAN \tag{2}$$

where

$$C_2 = V + ODP + EMO + EMV + IM \tag{3}$$

and V – manufacturing costs per one unit of product
ODP – quantity of solid wastes
EMO – quantity of emissions
EMV – quantity of liquid wastes
IM – quantity of imissions inside the factory
INV – capital expenditure in connection to the environment protection
SAN – costs depending from the environment degradation (fines, fees, etc.)

The total costs for the manufacturing of **x** products in a factory, can be expressed as

$$K(x) = K_1(x) + K_2(x)$$

and applying the substitutions – including $C_3 = INV + SAN$ too, the following equation is obtained

$$K(x) = C_1/x + C_2 \,.\, x + C_3 \tag{4}$$

After the differentiation of the equation (4), the optimal number of products $\mathbf{x} = \mathbf{x_{opt}}$, and the corresponding quality of environment, in connection to the factory influences are obtained.

$$x_{opt} = \sqrt{\frac{C_1}{C_2}} \tag{5}$$

The graphical interpretation of these results is given in Fig. 1.

Discussion

- The curve K(x) sometime called as **the curve of the sustainable development** - has its minimum (point A), and represents, according to some approach, the compromise solution between the economic and the environmental demands on the micro-economic level.
- Consumption of the natural capital (habitually per annum) is gradually reduced by growing production, which is compensated with costs - to eliminate this consumption. Point B represents equality of both - costs and thus the **economic optimum of the environment quality - Q_{opt}.**
- The environment quality in this case is in connection to the concrete mechanical engineering factory. If the **x = 0, C_2 = 0** too, the corresponding **Q = 100 %**, and the natural capital **C_1** has not been consumed, too.

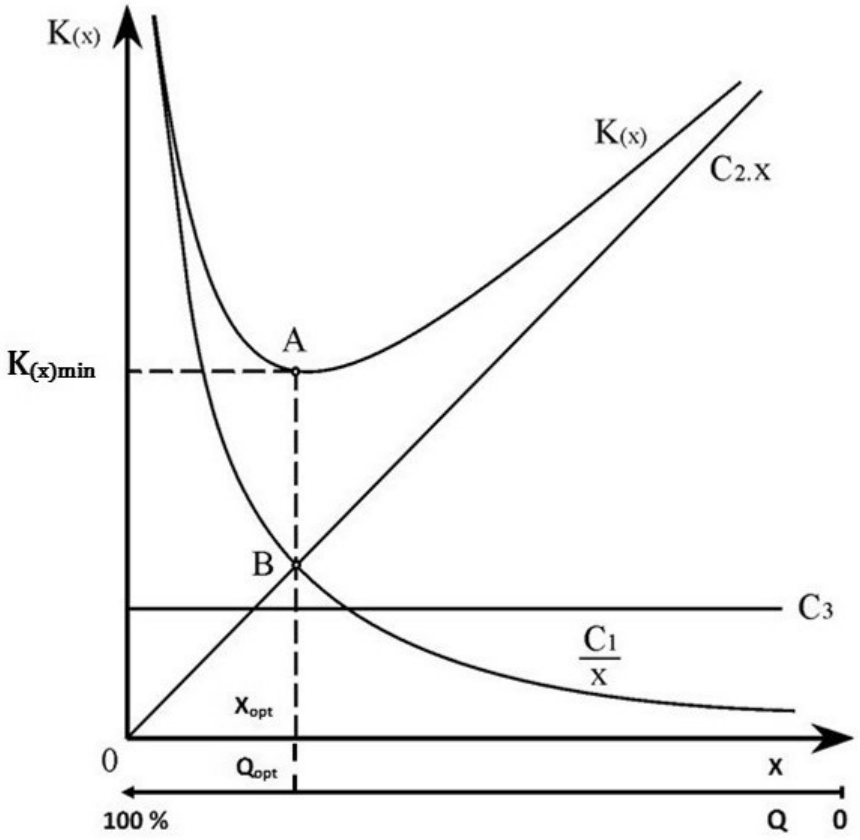

Fig. 1. Graphical interpretation of the compromise solution between the economic and the environmental demands in the mechanical engineering industry

- The environment protection costs have their initiation part of the constant value, which consists of the capital expenditure part **INV** and constant payments **SAN.** It is presumed that **SAN = const,** to the $\mathbf{x = x_{opt}}$ value. If $\mathbf{x > x_{opt}}$, it will probably depend from the other concrete conditions.
- Perhaps, the presented method and approach can be applied to some parts in the LCC (Life Cycle Costing) analysis.

An application in the automotive industry

The basic input data, according to the [7,8] are the following:
$C_1 = 1{,}8.10^{20}$ € / year, $C_2 = 1{,}65.10^{9}$ € / year, and C_3 has a marginal value. The corresponding graph is in Fig. 2.

X_{opt} = 330 000 cars/year, quality of environment for the given conditions**:** Q_{opt} = 67 %.

If the theoretical value of the environment quality Q_t = 100 %, then it is reduced according to the formula:

$$Q_t - Q_{opt} = 100\% - 67\% = 33\ \%.$$

Of course, the financial quantification and expression of these data is possible too. It depends from the monetary system.

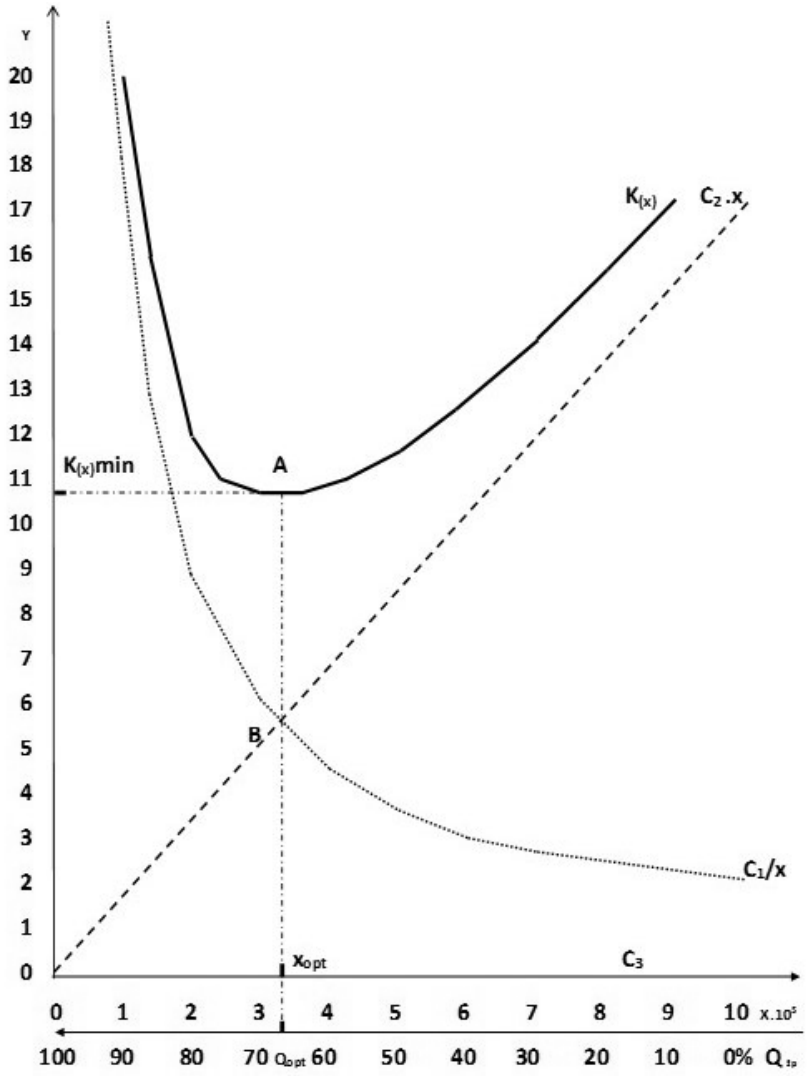

Fig. 2. Results from the personal car production in a ME factory

It is possible to declare according to the applied procedure: **the quality of environment has the quantitative value!**

Conclusion

There is the need for systematic approach to organize a factory in such a way, that improve the environmental and economic performance of their products across product life cycles becomes an integrated part of operations and strategy [1]. Determination of the optimal quality of environment and the optimal production volume for the given conditions has operational and strategic purpose, too [7]. The described method represents the way, how to determine them. An application, for example, in the automotive industry this approach can bring not only environmental, but also economic benefits [8,10].

At the present time, the research program in this field is continuing, and is concentrated and applied in some factories in Slovakia for personal cars production.

References

[1] Žiga, P.: Operational Program – Quality of Environment (in Slovak). Enviromagazín, 5/2014, p. 7, ISSN 1335-1877
[2] Húska, M.: Priority is – Better Quality of Environment (in Slovak). Enviromagazín, 5/2014, p.8-9, ISSN 1335-1877
[3] Opinion of the European Economic and Social Committee on Industrial Change in Mechanical Engineering Sector (2005/C 267/02)
[4] Gray, M.: Geodiversity: Valuing and Conserving Abiotic Nature. J.Wiley & Sons, Chichester 2010, 260 p.
[5] Muránsky, J.: Determination of the Optimal Production Volume Respecting the Environmental and Economic Criterions. In: maa 2012**,** 11th Int. Scient. Conf., Novi Sad, Serbia, Sept. 20-21, 2012, pp.373-376, ISBN 978-86-7892-429-3
[6] Muránsky, J.: Environmental Evaluation of Mechanical Engineering Works. In**:** Etikum 2014, Int. Scient. Conf., Novy Sad, Serbia, June 2014, ISBN 978-86-7892-616-7
[7] Available from: http://www.portal.statistic.sk/showdoc.do?docid=37945
[8] Available from: http://www.teeb.ecosyst/stud/eu-0810/an_2010^
[9] Muránsky, J.: Environmental Compatibility of the Mechanical Engineering Products (in Slovak). SD(VLK), 2008, p.300, ISBN 978-80-96988-9-2
[10] Available from: http://www.cecs.pdx.edu/~herm/capstone/mee9899/491stuff/mon7/

Deep Catalytic Methane Oxidation at the Clinoptilolite

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Abstract

Five specimens of the natural clinoptilolite-based catalysts (Sokyrnytsya deposit, Ukraine) have been prepared for the purpose of studying some of their physical and chemical characteristics (specific surface and its acidity, total pore space). The above catalysts have been studied in the reaction of deep methane oxidation. It has been shown that the natural clinoptilolite possesses the maximal carbon dioxide selectivity (97%), though the activity of all specimens under study remains quite low (i.e. the degree of methane transformation does not exceed 30%). It has been found that the cause of the carbon dioxide selectivity reduction at the modified specimens is the increase of the formaldehyde yield. A scheme of the deep methane oxidation at the catalysts under study has been suggested.

Key words: *clinoptilolite, catalyst, oxidation, methane*

Introduction

The rational environmental management and protection are being the hot topics gradually occupying the leading place among the global problems of modern times. The further use of the novel technologies accelerates the ecological crisis due to the increase of contaminations involved in the environment. In accordance with the results of studies carried out by a number of economists, the influence of the technological factor on the crisis situation is determinative [1]. The more products are manufactured to satisfy the needs of the mankind, the more complicated are the environmental problems. However, in the technological production, the problem of the human work that specifies the economical expediency of the social production is only a part of the resources used. Another part of production is, as a rule, larger by its mass, these are the scrap materials that come into the environment and require for their utilization the additional financial and material expenses.

The deep methane oxidation reaction is used in a series of devices, i.e. in catalytic heaters, catalytic systems for air cleaning of the exhaust engine gases and the industrial enterprise waste etc. Methane is an extremely inert substance, therefore for the reaction of its oxidation the high temperatures, and, as a result, high energy consumption are required. In addition, at high temperatures due to the oxidation of nitrogen present in air its oxides are produced being extremely harmful for the environment [2]. Therefore, reduction of the reaction temperature to reduce the energy consumption and improve ecology is a hot topic of studies.

The catalysts made of the noble metals deposited onto different carriers [3–4] as well as mixed oxides of transient metals [5] have shown themselves well in the reaction of deep low-temperature methane oxidation. In addition, the vast studies are being carried out on investigating the possibility of the use of natural zeolites as deep oxidation catalysts [2, 6].

In this paper, the natural zeolite clinoptilolite and its modified forms have been studied in the reaction of deep oxidation of methane.

Experimental

The natural clinoptilolite from the Sokyrnytsya deposit (Ukraine) [7] was chosen as the initial object of our studies. Zeolite was modified in three stages.

1. To obtain dealuminated specimens the initial natural clinoptilolite with 3–5 mm particles size was treated by the 5N solution of the chloride acid (with the solid to liquid ratio of 1:1.25) at the water bath temperature during three hours with periodical stirring. The specimen obtained was thoroughly washed by the distilled water up to complete elimination of the chlorine ions and dried in the air at room temperature.
2. The dealuminated specimen was decationized by a salt treatment using the 3M NH_4Cl solution (with the solid to liquid ratio of 1:10) during three hours. The specimen obtained was thoroughly washed by the distilled water and dried in the air at room temperature.
3. The dealuminated and decationized specimens of the clinoptilolite layer for ion exchange were treated by the 2N solutions of the Cu^{2+}, Cr^{3+}, Co^{2+} salts. This treatment was also carried out for three hours at the water bath. Then the specimens were thoroughly washed by the distilled water and dried in the air at room temperature.

The air-dry specimens were heated at the 393K temperature for five hours and incinerated during three hours at the 823K temperature. As a result of such treatment, five catalyst specimens were obtained: the initial natural clinoptilolite (Zeolite-natural); the specimen substituted by the NH_4^+ ion – the hydrogen form (Zeolite-H); the specimen substituted by the Cu^{2+} ion (Zeolite H-Cu^{2+}); the specimen substituted by the Co^{2+} ion (Zeolite H-Co^{2+}) and the specimen substituted by the Cr^{3+} ion (Zeolite H-Cr^{3+}).

After the thermal treatment at relevant temperatures the acidity on the catalysts surface was determined as well as their specific surface and pore space. The surface acidity was determined by the amine titration of the benzene suspension of the specimen in the presence of the Hammet indicators, i.e. by the Johnson's method; the specific surface was determined chromatographically by the low-temperature nitrogen adsorption using the BET method, while the pore space was determined by the benzene vapor adsorption [8].

The kinetic experiments on the methane oxidation were carried out in the differential reactor at the flowing-type apparatus. The mixture under study comprised 67% of methane and 33% of oxygen. Reaction products were analyzed chromatographically [9]. To obtain the satisfactorily reproducible experimental data, the above apparatus was turned on for a long time of continuous work. The experiments were carried out serially. Before the beginning of each particular series the catalyst was activated under the conditions of the previous series. After reaching the stationary activity of the catalyst the control experiments were carried out.

Results and Discussion

The clinoptilolite content in the zeolite layer of the Sokyrnytsya deposit is 70–90%. By its chemical composition it belongs to the alumosilicates of the sodium-potassium type with quite large calcium content. The gross formula of zeolite is $(Na_2K_2Ca)O \cdot Al_2O_3 \cdot 7SiO_2 \cdot 6H_2O$. The harmful

elements content does not exceed the following quantities: Pb – $3\cdot10^{-3}$%, Zn – $4\cdot10^{-3}$%, Cu – $1{,}5\cdot10^{-3}$%, As – $1\cdot10^{-3}$%.

Table 1 shows some physical and chemical characteristics of the catalysts under study.

Table 1. Physical and chemical characteristics of the catalysts under study

Catalyst	Specific surface S, [m^2/g]	Total pore space [cm^3/g]	Surface acidity [mole ekv/g]	
			Before catalysis	After catalysis
Zeolite-natural	86	0.013	0.0696	0.0647
Zeolite H	96	0.243	0.1814	0.1794
Zeolite H - Cr^{3+}	127	0.121	0.2181	0.2093
Zeolite H - Co^{2+}	83	0.117	0.2291	0.2214
Zeolite H - Cu^{2+}	140	0.080	0.2401	0.2345

The clinoptilolite layer of the Sokyrnytsya deposit is characterized by a high thermal stability due to its strong silica properties. The optimal activation temperature is 600–700K. The water starts to excrete only at heating above 600K.

As seen from the entries of Table 1, the natural clinoptilolite modification results in the change of its physical and chemical properties, i.e. the specific surface, total pore space and surface acidity. The specimen modified by the Cu^{2+} ions (Zeolite H - Cu^{2+}) has the maximal specific surface (140 m^2/g) and the maximal acidity. Reduction of the specimen acidity after the catalysis is, probably, related to the decrease of the number of surface hydroxyl groups.

The specific catalytic activity of the catalysts under study (see Table 2) with respect to the total process of methane oxidation under the stationary conditions increases in the following series: Zeolite-H < Zeolite H – Co^{2+} < Zeolite H – Cr^{3+} < Zeolite H – Cu^{2+} < Zeolite-natural.

Table 2. Catalytic properties of the clinoptilolite forms under study (T=673K, $[CH_4]:[O_2]=2:1$, τ=6c)

Catalyst	Specific catalytic activity $W\cdot10^{10}$ [$mole/(m^2\cdot s)$]	Selectivity S [%]		Concentration of CH_2O [%]
		S_{HCHO}	S_{CO2}	
Zeolite-H	1.00	11.8	68.3	0.12
Zeolite H - Co^{2+}	1.17	13.5	67.3	0.14
Zeolite H - Cr^{3+}	1.19	57.9	31.6	1.1
Zeolite H - Cu^{2+}	1.38	11.3	49.3	0.23
Zeolite-natural	2.69	9.1	74.6	0.22

The main product of methane oxidation at the natural clinoptilolite is carbon dioxide with concentration in the mixture at the 923K temperature of about 10 vol.% (see Fig. 1, curve 1).

At the same time, and this is very important for the deep oxidation catalysts, the total concentration of formaldehyde and carbon monoxide in the reaction products does not exceed 0.5% (Fig. 1, curves 2, 3). However, the practical application of the natural clinoptilolite is embarrassed by the fact that in the course of hydrocarbons transformation it is rapidly deactivated due to deposition of reaction products in the narrow pores of the catalyst.

To elucidate the influence of dealumination and decationization of the natural clinoptilolite on the methane oxidation process we have used its modified forms as the catalysts (see Fig. 2). As seen from this figure, carbon dioxide selectivity at the natural clinoptilolite is maximal and reaches 97% at 923K.

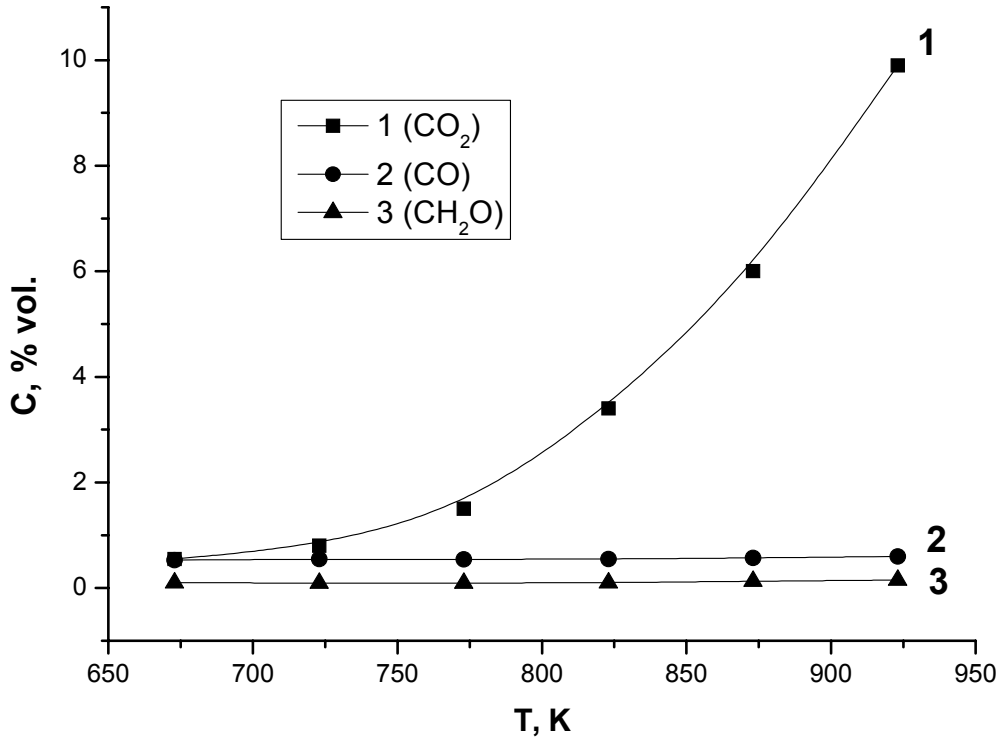

Fig. 1. Reaction product yield as the function of temperature at methane oxidation at the natural clinoptilolite $[CH_4]$: $[O_2]$=2:1, τ=2c

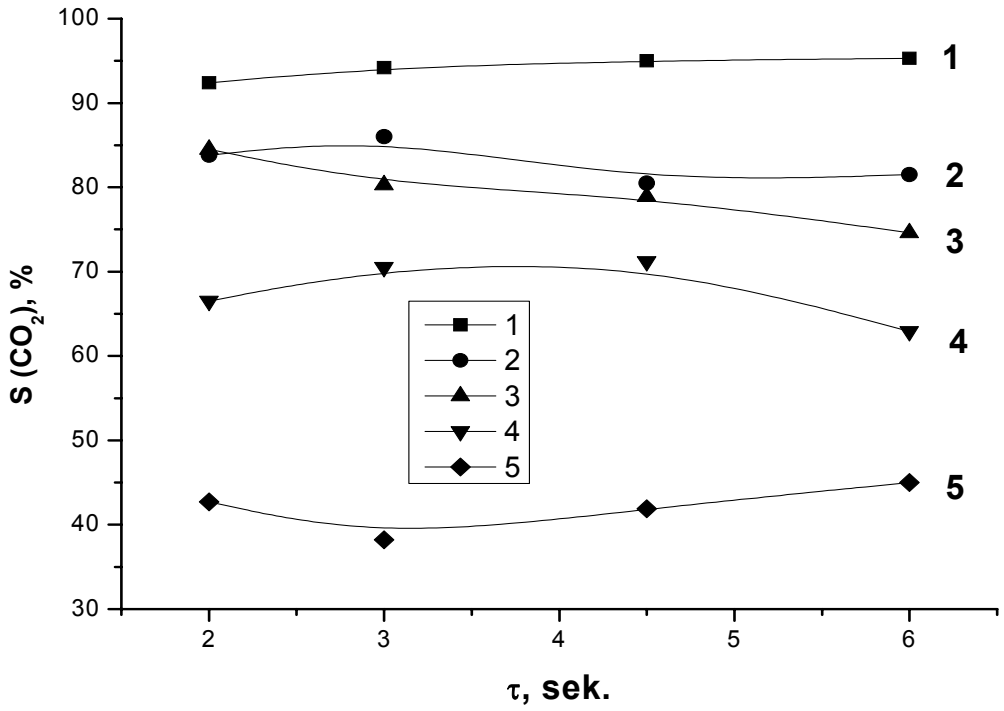

Fig. 2. Carbon dioxide selectivity as the function of time τ of the reaction mixture contact with the catalyst at the specimens under study - $[CH_4]$:$[O_2]$=2:1, T=923K, 1- Zeolite-natural; 2- Zeolite H - Co^{2+}; 3 - Zeolite H - Cu^{2+}; 4 - Zeolite-H; 5 - Zeolite H - Cr^{3+}

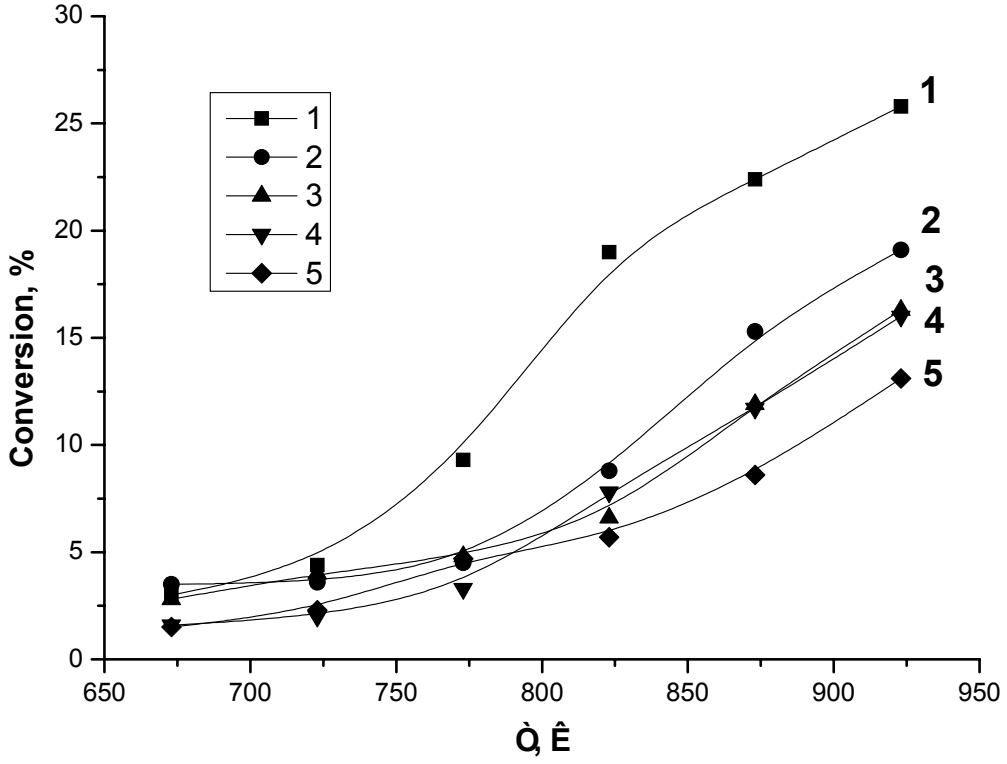

Fig. 3. Methane transformation degree as the function of temperature - CH_4]:[O_2]=2:1, τ=6c,
1 - Zeolite H - Cu^{2+}; 2 – Zeolite-natural; 3 - Zeolite H - Cr^{3+}; 4 - Zeolite H - Co^{2+}; 5 - Zeolite-H

It should be noted that the natural clinoptilolite modification results in the decrease of carbon dioxide selectivity and, according to this parameter, the catalysts form the following series: Zeolite H – Cr^{3+} < Zeolite-H < Zeolite H – Cu^{2+} < Zeolite H – Co^{2+} < Zeolite-natural.

Carbon dioxide selectivity at the modified specimens decreases due to the formaldehyde yield increase. While the maximal formaldehyde selectivity at the natural clinoptilolite does not exceed 2%, that at the specimen modified by the chromium ions (Zeolite H – Cr^{3+}) is approximately 60%, whereas the formaldehyde yield at the 923K temperature and the 6 s time of the reaction mixture contact with the catalyst reaches 5.7%.

The methane transformation degree is not less significant characteristic of the catalyst. As seen from Fig. 3, the most active is the clinoptilolite form modified by the copper ions (Zeolite H – Cu^{2+}), for which the methane transformation degree reaches 25% (see Fig. 3, curve 1). The less active is the hydrogen form of the clinoptilolite (Zeolite-H) (see Fig. 3, curve 5).

It is known that the transient metal oxides push the oxidation process towards the carbon dioxide formation; therefore, the part of the zeolite surface not modified by the metal ion is, probably, responsible for the formation of the products with lower oxidation degree. At low temperatures (723K) the acidity of the specimen surface has almost no effect on the carbon dioxide production rate (see Fig. 4, curve 1). At higher temperatures (see Fig. 4, curves 2, 3) the carbon dioxide production rate is high at the specimens with minimal (Zeolite-natural) and maximal (Zeolite H – Cu^{2+}) surface acidity.

One may assume the following mechanism of a complicated multistage process of selective methane oxidation into the oxygen-containing products. Deep oxidation occurs via the formation of an intermediate compound (ZCH_2O) (here Z being an active centre of the catalyst). Existence of such compound was proven in [10]. Formaldehyde is produced at the intermediate compound desorption from the surface into the bulk:

$$ZCH_2O \xrightarrow{k_1} HCHO + Z$$

The ZCH_2O compound is oxidized producing the formiate complex ZHCOOH, which at the spontaneous decay produces carbon oxide CO:

$$ZCH_2O + ZO \xrightarrow{k_2} ZHCOOH + Z$$

$$ZHCOOH \xrightarrow{k_{CO}} CO + H_2O + Z$$

Carbon dioxide is produced at full oxidation of the surface complex ZHCOOH by the molecular oxygen:

$$ZHCOOH + O_2 \xrightarrow{k_3} CO_2 + H_2O + ZO$$

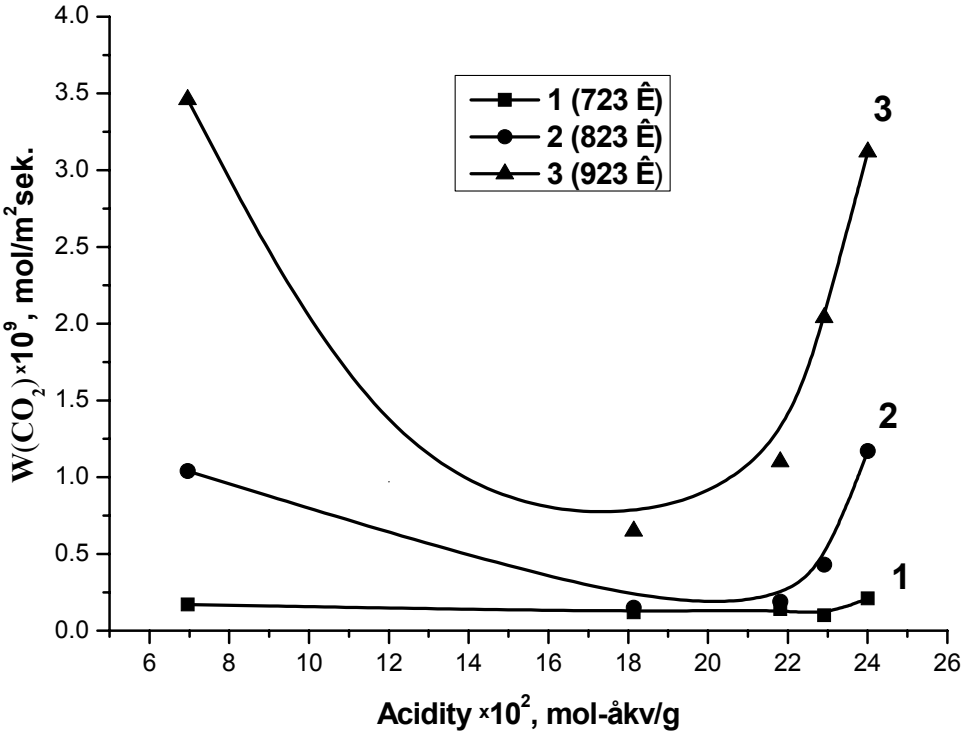

Fig. 4. Comparison of the carbon dioxide production rate with the specimen surface acidity $[CH_4]$: $[O_2]$=2:1, τ=2c

Conclusions

The natural clinoptilolite even without chemical modification is an active catalyst of deep methane oxidation. Modification of this catalyst by the transient metal ions results in the reduction of carbon dioxide selectivity due to the formaldehyde yield increase. It should be noted that activity of both the natural clinoptilolite and its modified forms is low and the natural clinoptilolite modification should be directed towards increasing the catalyst activity. Among the normal alkanes, methane is the most difficult to be oxidized, therefore the reaction of its catalytic transformation may serve as a model one for any reaction of hydrocarbon oxidation by the molecular oxygen.

References

[1] Phirmundskij A.V., Kuzmin V.I.: Kriticheskije urovni v razvitiji prirodnikh sistem. Leningrad, Nauka, 1990, 223 (in Russian)
[2] Dzyamko V., Osiysky E., Milyan P.: Ecological Aspect of Deep Catalytic Oxidation of Hydrocarbons and Carbon Monooxide. Transactions of the Universities of Kosice, 2006, 1, 1-6
[3] Sarbak Z., Andersson S.L.T.: Effect of support and loading on oxidation of methane over platinum catalysts. React. Kinet. Catal. Lett., 92, 2007, 231-238
[4] Bozo C., Guil-haume N., Herrmann J.-M.: Role of the ceria-zirconia support in the reactivity of platinum and palladium catalysts for methane total oxidation under lean conditions. Journal of Catalysis, 203, 2001, 393-406
[5] Margolis L.Ya.: Okislenije uglevodorodov na geterogennikh katalizatorakh, Moskva, Khimiya, 1977, 326 (in Russian)
[6] Dzyamko V.M., Milyan P.M.: Klinoptilolite and its Application in Ecological Catalysis. 7th International Conference Solid State Chemistry, 2006, Pardubice, Czech Republic, September 24-29, 2006, 215-216
[7] Dzyamko V.M., Milyan P.M., Starosta V.I.: Dejaki phizuchni ta phizuko-khimichni vlastivosti prirodnogo zeolitu – klinoptilolitu. Nauk. visn. Volinskogo univ. Ser. Khimija, 15, 2007, 19-22 (in Ukrainian)
[8] Eksperimentalnije metodi issledovanija kataliza. Ed. R.M. Anderson, Moskva, Mir, 1972, 147 (in Russian)
[9] Dzyamko V.M., Osiyskiy E.Y., Gomonay V.I.: The chromatographic analysis of products of catalytic C_1-C_4 hydrocarbons conversion. International congress on analytical chemistry, Moscow, Russia, 15-21 june, 1997, 110
[10] Sokolovskij V.D. Mekhanizm kataliza i problema predvidenija kataliticheskogo dejstvija okisnikh katalizatorov v reakcijakh glubokoho okislenija, Novosibirsk, 1977, 33-35 (in Russian)

Using of Equity Statement in Corporate Financial Management

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Abstract

In present time we see increased interest of owners and shareholders to increase the value of their capital, as a result of what transactions and movements leads to the change and therefore, whether the enterprise manages its invested capital efficiently. Due to the mentioned Statement of Equity is introduced to follow the movement of individual items of equity during the accounting period. Searching had been made in chosen production organization in condition of Slovakia, where balance principle had been used as essential principle of searching. In the organization there was made possible establishment of equity statement. Through this statement organization could better understand information, provided in balance sheet and loss and profit statement, as well as find possible solution for its problems.

Key words: *international financial reporting standards, equity statement, financial management, Slovakia*

Introduction

International Financial Reporting Standards (the "IFRS") sets out the reporting obligations of full financial statements consisting not only of the balance sheet, income statement and cash flow statement, but in present time they are filled by Statement changes in equity of the company. Attachment to the financial statements should also include notes that explain the accounting policies and principles applied in the compilation of individual statements, including other explanatory factors for individual statement items. In present time we see increased interest of owners and shareholders to increase the value of their capital, as a result of what transactions and movements leads to the change and therefore, whether the enterprise manages its invested capital efficiently. Due to the mentioned Statement of Equity is introduced to follow the movement of individual items of equity during the accounting period.

Present state of problem solving

The financial situation of the company is a summary expression of results that the company achieved in certain areas of its activities. Information about quality of its production, level of business and market knowledge, innovation and other activities are reflected to the financial condition of company. From past experience it is clear that the existence of problems in the activity of the company is directly reflected in a worsening of financial situation.

During the production process there is always movement of assets and sources of its coverage, and these movements affect asset and liability items, and thus also the change in cash and profits that can be found in the balance sheet. Loss and profit statement explains the process of making a profit as a gain on equity, which is part of the liabilities in the balance sheet. Cash Flow statement allows explaining of changes in cash, forming part of the assets in the balance sheet. These statements are used differentially according to various levels of management of the company. In the case of strategic management balance sheet is used as the basis, while other reports, which are used more frequently and more regularly, are used at lower levels of management [7].

Businesses should create complete financial statements (i.e. Complete set of financial statements) as recommended by IFRS, consisting of five parts. The four financial statements that are presented at the same level are principally the equivalent component of the financial statements and are prepared in accordance with the general requirements for reporting of financial information. These are mandatory for all businesses regardless of their legal status, size or line of business. Banks and similar institutions have specific, additional requirements on the financial statements. Additional responsibilities in preparing the financial statements arise for those businesses that have a duty to publish information.

Equity can be generally considered as one of items that are directly connected with measurement of financial situation in company (connected with balance sheet). For users of financial statements information there is not enough to know state of individual items of equity, presented in balance sheet, but also information, connected changes of equity that rose in accounting period. Change of equity in the company between two days, constructed in balance sheet, are reflecting increasing or decreasing of net assets or wealth during given period, mainly with using of concrete processes of used and published data evaluation in financial statements.

International Accounting Standard – IAS recommends companies to install it as a special part of their financial statements, with reporting of following:

a) Loss or profit during given accounting period.
b) Cost and revenues in equity, which are in balance with other standards for every items, as well as sum of such items.
c) Total revenues and costs according structure of controlling company by rate of minority owner.
d) Influence of changes in balance policy and repair of mistakes in equity, made in company according IAS 8.

Except of mentioned items, company should report alternatively in Statement of equity or in notes also:

e) Capital transactions with owners from division of profit to owners.
f) Remain of not divided profit or not covered loss at the beginning of given period and its changes during accounting period.
g) Comparing of sum of every group of basic equity and capital funds, capital surplus and every reserve fund at the beginning and at the end of given period by special publishing of every change [10].

Changes in equity are caused mainly by transactions among shareholders and total cost and revenues, rising during accounting period; therefore following items should be added to components of statement of equity (SCE):

a) All capital transactions from owners of share and all payment to share owners.
b) Sum of not divided profit at the beginning of the period and to the day of annual balance sheet, as well as all changes during accounting period.
c) Changes in accounting value for every item of equity at the beginning and at the end of accounting period.
d) Sum of dividend, reported as division to owners during given period and sum of dividend per share (in case the information are not represented in notes) [8].

Users of financial statements, who wish to have a better understanding of the equity reported in balance sheet can read more about it and analyze Statement of equity for further understanding of company activities. Balance sheet speaks about financial position at a certain time, while the income statement (loss and profit) shows the financial performance of company over a certain period of time. Although the two main components of the financial statements provide important financial information, the information may become limited at some point. For this reason, it is necessary to prepare a separate part of the financial statements (i.e. SCE), which will complete the wider interests of users. SCE presents changes in equity reported in the balance sheet for a certain period or for the period from the beginning to the end of the reporting period. Moreover it reports how comprehensive income (profit or loss plus other complex income) recognized in the Income statement impacts on equity during certain period of time [1].

The aim, respectively purpose of SCE is to help users of financial statements to identify the factors, causing changes in owners' equity in given company during accounting period. Given that the movement of reserves of shareholders can be observed from the balance sheet, SCE reveals essential and relevant information about capital reserves, which are not separately listed in any financial statements. These can be useful in understanding of the nature of changes in equity reserves. Examples of such information include, for example, issue and subscription of shares and repayment during the accounting period, the acquisition of own shares, cash and stock dividends, the effects of changes in accounting policies and corrections of errors in previous period, gains and losses recognized outside income statement, dividends declared and bonus shares issued in the accounting period, or other transactions with owners [2].

Thus, users of this statement, especially owners and investors, can learn about influences of the changes to the performance or operation of the company and other related factors on wealth and capital invested by them in their business. Users of this statement may additionally also analyze how capital or funds were used, which were flows of capital or equity during the accounting period. In other words, the owners or co-owners of that business, it is important to learn how these factors and transactions affect money or capital invested into the business [1].

Comparing of establishment of SCE in chosen national accounting legislation

Under IFRS, the statement of equity changes provides for each category of equity changes, resulting from profit, other comprehensive income of transactions with owners. Statement contains information on total comprehensive income, showing separately the amounts belonging to owners of the parental company and non-controlling rates, the impact of retrospectively change of accounting method and retrospective recalculation.

According to Czech accounting legislation, the statement of equity changes is not mandatory, with the exception of selected companies. Movements in equity may be listed in Annex instead of separate statement [6].

According to German GAAP (Handelsgesetzbuch - HGB), the statement of equity changes is required only in the consolidated financial statements as well as public traded companies that are not obliged to prepare consolidated financial statements. The recognition of gains and losses in equity is permissible under business accounts only in a few exceptional cases. Changes in equity, to be included in the statement of equity changes are modified according German Accounting Standard 7 (GAS 7). Statement of equity changes must be presented as the primary document of financial statements [9].

According to Austrian accounting legislation (Unternehmensgesetzbuch - UGB) there is a special feature that the results are not recognized in the income statement, but directly in the equity. Movements in equity result from the evaluation of individual assets by fair value. As the losses and gains are not recorded, they decrease or increase equity without influence to the income statement. Therefore, SCE is a mandatory part of the financial statements, as the equity bookkeeping together with the result, reported in the income statement represents the overall result during given accounting period [3].

According to the Hungarian accounting legislation, the financial statements should include primary statement reflecting all changes in equity, e.g. SCE. However, we can speak about diversity in recording practice regarding the level of detail presentation of information in the SCE relating to the movement of other comprehensive income (Other Comprehensive Income - OCI) [4].

Under Swiss accounting legislation, SCE, is only added in financial statements as an attachment. This attachment contains more detail financial information. However some companies indicate SCE as a primary document to the overall financial statements [5].

Methods of searching

Essential principles of searching are based on the balance principle, which sees property from two points of view, mainly in what form the asset exist in the company and from what source they are financed. Basically there must be equality of sources and property.

Other method of searching presented so-called binate procedure, mainly analysis and synthesis, induction and deduction. During analyzing of financial situation of three years there were used mainly methods of comparison of individual accounting period with aim to prove factors, influencing economy of the company significantly. At the same time analysis of financial situation in the company had been made by connection of individual balances of company according four's balance principle of financial statement. Format for Statement of equity provides Fig. 1. Searching had been made in organization JP Production, Ltd., acting in Slovakia eight years from 2006, and dealing with construction of machinery products. It presents Danish Slovakian development and Production Company.

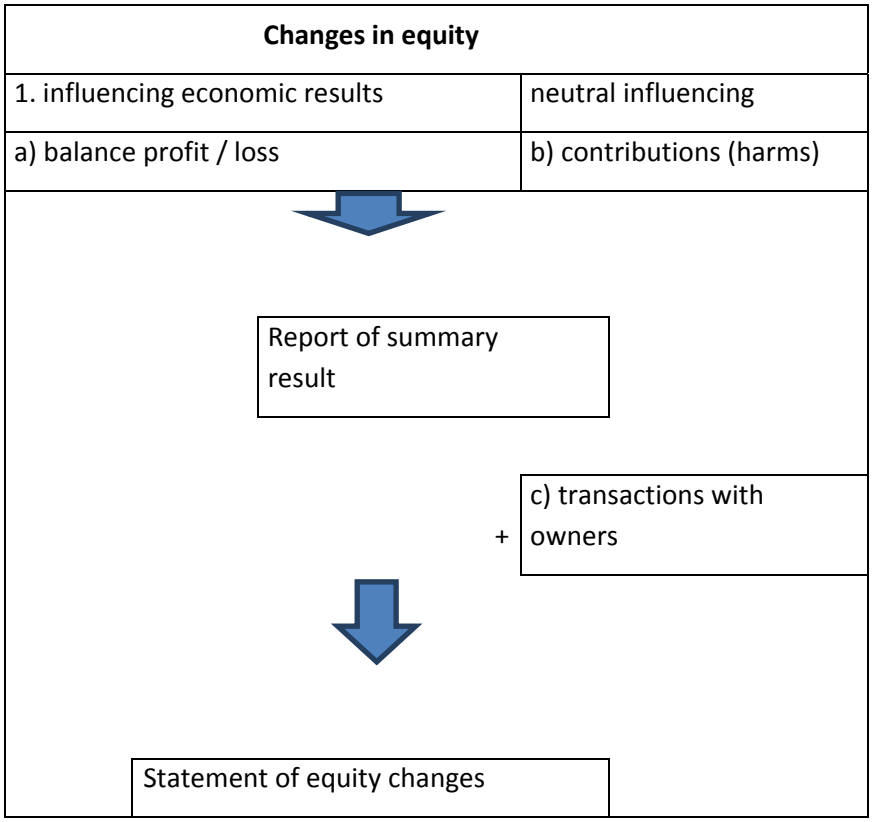

Fig. 1. Statement of equity changes [8]

Analysis of equity in the company

In the financial statements in the period to 30th June 2012 we see that the company owned assets in the amount of 383,493 €, representing an increase over the previous year of 145,794 €. This increase was caused primarily by increasing of current assets value by more than 100 thousand €, of which a significant portion belongs to growth of short-term receivables and financial accounts. From the side of liabilities, equity value consisted of 212,502 €, which means an increase of nearly 60 thousand € compared to the immediately preceding accounting period. Equity value was higher than that of the total liabilities, of which the total sum 170 991 € accounted for the largest share of mainly short-term liabilities, primarily short-term trade payables and payables to partners and association.

In balance sheet there is an important item Economical result (hereinafter referred to as "ER") for the accounting period after tax in the amount of 92,484 €, and loss and profit statement explains the way in which it was generated, i.e., of what costs and revenues it was generated. Economical result, whether in the form of profit or loss, is calculated as the difference between revenues and expenses during the given accounting period. This year the company achieved a profit, since revenues in the amount of 1,131,266 € were higher than the costs in the amount of 1,038,782 €. The largest share of the profit was mainly revenue from sale of property, which means 1,045,019 € that were several times higher than all other items of income. The company in the period invested costs on a large scale, mainly for goods sold and for production consumption, from which the highest proportion accounted for costs of services (more than double the cost of material and energy consumption, and other non-storable supplies).

An economical result from loss and profit statement is reflecting to the SCE in two ways:

- If an economical result presents profit, it increases equity.
- If an economical result presents loss, it decreases equity.

In our case, as mentioned above, the company achieved a profit in accounting period, according which equity had increased. Company transferred part of profit to retained earnings from past years and remain part was used to increase equity by 61,534 €. During the accounting period retained earnings from past years reduced by the amount of 1,951 €. Following these changes, equity rose to 212,502 €.

During period from 1st July 2011 – 30th June 2012 value of own equity was 121 969 €. From notes we can see change of one element in equity, mainly not undivided profit from last years, which decreased by 1 951 €. By this value equity must be adapted, since any other element of equity did not change. Except of undivided profit from previous years equity is created also by legal reserve fund, which had at the beginning and at the end of accounting period value 332 €. Volume of equity at the end of accounting period presented 120 018 €. Since from the mentioned theory we know that economical results can be profit or loss, considered during equity calculation, value of equity is therefore adapted by volume of achieved accounting profit of given organization and by this way we can calculated total value at the end of the period (see Tab. 1).

During accounting period from 1st July 2012 to 30th June 2013 equity presented 120 018 €. Similarly as in previous case accounting unit recorded in notes change of only one element, which was also undivided profit from previous years, but it increased by 61 656 €. Equity had been increased by this value. Similarly as in previous accounting period any other element of equity did not change. Change of legal reserve fund was at the same level. Equity at the end of accounting period presented 181 674€. Company achieved economical result - profit and therefore we need to adapt volume of equity by profit, therefore total value of equity at the end of accounting period would present 283 760 €.

During 1st July 2013 to 30th June 2014 equity increased considerably against previous accounting period approximately by 100 000€. Basic equity did not change against previous period. As for the change in funds, made from profit there was increasing of reserve fund from 332€ to 4425€. Economic results recorded slow increase by 1836€. Greatest change of equity was in economic results after taxation, which decreased considerably in comparing with previous year and therefore company recorded loss 23 049€. Only in 2014 there was profit 102 086€.

Tab. 1. Statement of Equity in JP Production, Ltd.

Item of equity		State at the beginning of accounting period	Growth	Decline	Transfer	State at the end of accounting period
Basic equity	2012	44 247	-	-	-	44 247
	2013	44 247	-	-	-	44 247
	2014	44 247	-	-	-	44 247
Legal reserve fund (undivided fund) from capital deposit	2012	332	-	-	-	332
	2013	332	-	-	-	332
	2014	332	4 093	-	-	4 425
Undivided profit from previous years	2012	77 390	-	1951	-	75439
	2013	75 439	61 656	-	-	137 095
	2014	137 095	102 086	100 250	-	138 931
Economic results in accounting period	2012	-	-	-	-	-
	2013	-	-	-	-	-
	2014	102 086	-	102 086	-	0
Together	2012	**121 969**		**1 951**		**120 018**
	2013	**120 018**	**61 656**			**181 674**
	2014	**283 760**	**106 179**	**202 336**	**-**	**187 603**

Note: Symbol „-„ means in given accounting period there were any change of item [Source: own processing according data JP Production, Ltd.]

Discussion

In many practical cases establishment of equity statement can be made in companies as following of net business equity, since basic equity present own sources of property covering in organization, and at the same time it presents index of financial stability of business organizations. Construction of equity change receives more and more importance, mainly in cases of big business companies, where it is constructed in the frame of consolidated financial statements. In such case it presents individual report. In special cases some companies, making individual financial statements, leading bookkeeping according international accounting standards, construct equity statement as well. Small business unit does not have obligation to construct equity statement. In notes of small business unit there is any claim to publish review about equity movement, as it is in case of big companies.

According performed analysis of equity in analyzed company we can state company should construct equity statement as individual report, not as a part of notes. It results from the fact company acts at market relatively short time and it has good assumptions to increase its market rate. Due to the mentioned we expect also obtaining of new movements of equity elements, which should be followed up and therefore they should be part of this report as individual statement, provided information for owners, shareholders or managers of the company. But according legislation it is up to the business unit (small business unit) to decide how to process during construction of financial statements in 2015 according individual measurements.

Conclusion

In last period we are witnesses of gradual harmonization of accounting and reporting of individual national accounting regulations, mainly due to the International accounting standards. These standards are visibly emphasizing standardization at the international level. According

international standards national accounting systems and agencies, published measurements of accounting, should act according them.

Important part of international standards is establishment of equity change. This statement connects with measurement of financial situation in the company and it points to changes in equity during accounting period. In the statement we can see how economic result influence own sources in given company. Except of mentioned statement is determined for users of financial reports, which want to have much brighter review about flows, leading to values, reported in balance sheet and loss and profit statement.

International financial reporting standard recommend establishment of equity statement as primary report, while Slovakian accounting standards report the statement only as part of notes to financial statements. On the other hand Slovakian accounting standards have the same decree together with IFRS to include every change to equity. IFRS mentions revenues and costs directly in equity, while Slovakian accounting mentions only some transactions directly in equity.

Possible establishment of equity statement had been proved in chosen company. Company recorded growth of economic results, value of property, as well as equity and cash flow increase till 2013. But in last period there was worsening of financial situation, company recorded loss, decrease of property, equity and cash flow recorded negative value. Construction of new report by the way of equity changes following could present possible tool how to find out possible reasons for such worsening situation. By this way company could also better understand information, provided in balance sheet and loss and profit statement.

References

[1] Abrugar, V.: What is a Statement of Changes in Equity and its Purpose? Available at: <http://businesstips.ph/what-is-a-statement-of-changes-in-equity-and-its-purpose/>
[2] Accounting-Simplified.com 2010-2013. Statement of Changes in Equity. Available at: <http://accounting-simplified.com/financial/statements/statement-of-changes-in-equity.html>
[3] Bierbach, Binder, G.: IFRS und Unternehmensbesteuerung Available at: <http://opac.fh-burgenland.at/repository/diplomarbeiten/AC07728566.pdf>
[4] DTTL 2011. IFRS Survey 2011 : Focus on financial reporting in Hungary. Available at: <http://www.iasplus.com/en/publications/hungary/other/ifrs-survey-2011-2014-focus-on-financial-reporting-in-hungary/at_download/file/IFRSsurvey2011HU_EN.pdf>
[5] DTTL 2014. Financial reporting by listed companies : Spotlight on Swiss trends. Available at: <http://www2.deloitte.com/content/dam/Deloitte/ch/Documents/audit/ch-en-audit-ifrs-survey-october-2014.pdf>
[6] Ernst & Young, s.r.o., 2013. Stručný přehled mezi Mezinárodními standardy účetního výkaznictví a českou účetní legislativou. Available at: <http://www.ey.com/Publication/vwLUAssets/FAAS_brochure/$FILE/FAAS%20Brochure%2010_2013%2008-FINAL.pdf>
[7] Kádárová, J. et al.: Riadenie finančnej situácie podniku a finančná kríza v podniku. Available at: <http://www.sjf.tuke.sk/transferinovacii/pages/archiv/transfer/11-2008/pdf/107-110.pdf>
[8] Krištofík, P.: Finančné účtovníctvo a riadenie s aplikáciou IFRS. Bratislava: Iura Edition, 2011, 803 p.
[9] PricewaterhouseCoopers: IFRS versus German GAAP (revised). Available at: <https://www.pwc.com/gx/en/ifrs-reporting/pdf/IFRS-vs-German-GAAP-Similarities-and-differences_final2.pdf>
[10] Šlosárová, A.: Prehľad peňažných tokov. Bratislava: Iura Edition, 2011, 216 p.

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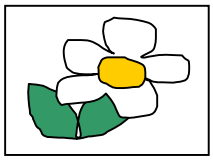

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[2] Van Loon J.C.: *Selected methods of trace metals analysis*. J. Wiley, New York, 1991

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