Involving students to industrial projects

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***Abstract* – The paper describes examples of a student participation in industrial project, which are granted for the Institute of Thermal Technology. This is a volunteer participation in the frame of Student Scientific Club. The role of such action, in a whole teaching process, is described and discussed. Main encountered problems and plans for future are discussed.**

Index Terms – scientific club, industrial project, learning by doing

ROLE OF A PROJECT IN EDUCATION

A well educated student should has no difficulties in finding a challenging, well paid and satisfying job, not only just after the studies but also in a future career. This is not so easy, since the industrial reality changes very fast and usually knowledge gained some years ago is not relevant for the current industrial technologies. Fortunately physical laws, which are the base for any technical solution remain unchanged. For example second law of thermodynamic is exactly the same no matter if it is applied for the steam locomotive or for modern nuclear plant. Therefore two crucial elements in education are as follow: possessing the knowledge on these physical laws and ability of application for understanding and designing technical solutions. This guarantee success of education.

Usually in each curriculum two phases can be distinguished. First of these phases is devoted for teaching basic subjects such as mathematics, physics, chemistry, thermodynamics and others. The second phase is on technical solutions, industrial applications etc. In fact this second phase should be mainly oriented to exemplification of basic subjects in real industrial solutions. In this second phase the most important thing is to teach students how the basic physical laws are applied in an industrial applications. The interdependence of these phases is presented in Fig.1.

Teaching of basic subjects is usually split to lectures, classes and laboratories, which all together allow to understand physical laws and their consequences. Teaching of application of laws usually is done by projects, seminars and lectures on industrial solutions. Probably the most important role, in this second phase, play projects. While preparing a projects students perform learning-by-doing and thus may better understand application of physical laws.

It would be most desired situation if projects, done by students, could be materialized in a form of real product. Unfortunately this is too costly and most of universities can not afford for that. However staff of the universities are, as a rule, involved in projects granted either by industry or by public organizations. This makes a possibility of involving students into a projects and thus open for them possibility of participating in actions which lead to solution of real industrial problems.

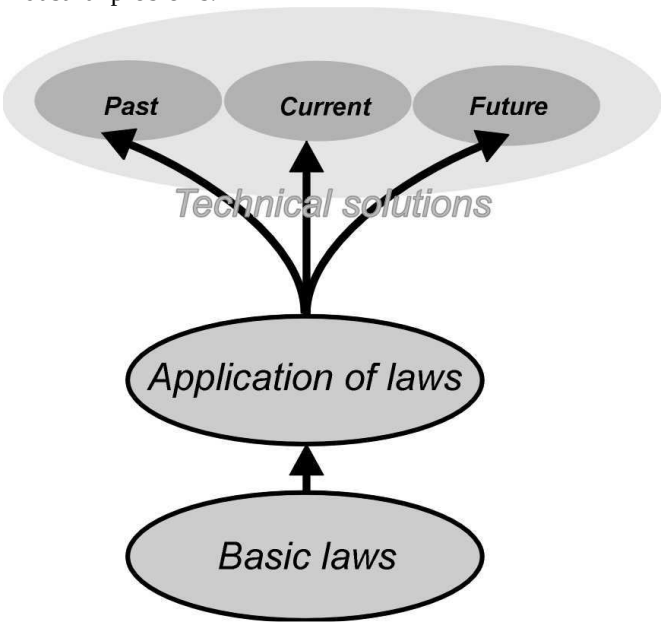

FIG.1 FROM BASIC PHYSICAL LAWS TO TECHNICAL SOLUTIONS

System of involving students to industrial projects was introduced in the Institute of Thermal Technology of the Silesian University of Technology in Gliwice. It was created recently therefore till now only preliminary results and conclusions are available. However this preliminary results are very promising.

SYSTEM DESCRIPTION

Mentioned system is organized within the Student Scientific Club and the web page plays a key role in it. Project coordinators publish on the web page short information on goals, timing, technical aspects of whole project and what do student are expected to do within it. Students apply for participation expressing their will of completing given tasks within expected time. Project coordinator choose the most suitable application and meet with the students in order to explain project details. Once a year there is organized a one-week seminar during which progress in projects or final

reports are presented. Below some example project which are performed by students are described.

Estimation of the corrosion rate of biomass fuelled boiler

The aim of this project is to estimate the corrosion rate of heat transfer areas of a boiler fuelled with straw. The project is granted by one of Polish heat plants which decided to use straw as one of energy sources for heat generation. In order to accomplish the goal of project selected boiler was equipped with devices for measuring mass flows of water and combustion air, temperatures and pressures inside a boiler. Moreover a control plates made of the same steel as whole boiler were located in selected, representative locations inside the boiler. Thickness of the plates was preciously measured before the tests. All operating parameters of boiler were measured and recorded. Basing on that amount of heat produced by the boiler as well as thermal efficiency, amount of burnt straw were calculated. The role of the students, which are involved in the project, was to propose the set of parameters which should be measured as well as they are supposed to perform calculations. Once a half-year control plates are dismounted from a boiler and measured. Project is ongoing and the expected end of the project is march 2008. Photo of a control plate is shown in Fig.2. As a result of participation student will get familiar with measuring technologies which are applied in the boiler as well as their will learn about corrosion problems.

FIG.2 PLOTO OF A CONTROL PLATE. AS IT WAS REMOVED FROM A BOILER (TOP) AND AFTER CLEANING (DOWN). ON THE BOTTOM PLATE VISIBLE LINES WHICH INDICATE MEASURING POINTS. REAL SIZE 100X50 MM [1]

Estimation of a NO reduction in stoker boilers

Stoker boilers are very popular sources of heat and steam in Polish industry because of simple construction and operation and excellent flexibility with respect to thermal load and fuel type. However NO emission from such devices is comparable with current environmental standards but higher than standards which are foreseen in nearest future. The aim of the project is to check, using mathematical modelling, if it is possible to reduce NO emission by proper distribution of a secondary air. Nowadays, in stoker boilers, both amount and direction of a secondary air can not be controlled and can be either switch on or off. It has been found that with switching off the secondary air NO emission decreases, however emission of incomplete product such as CO and CH increases above the allowed limits. In the project it is planned to perform series of CFD tests, which should answer the question if it is possible to keep the limits of both CO, CH and NO limits by proper directing and controlling amount of secondary air. The scheme of the stoker boiler is shown in Fig.3.

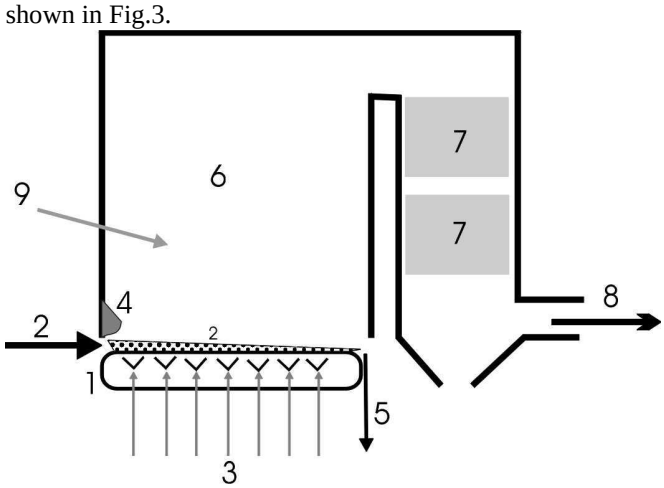

FIG.3 SCHEME OF STOKER BOILER. 1-STOKER, 2-FUEL, 3-PRIMARY AIR, 4-IGNITION WALL, 5-SLAG, 6-COMBUSTION CHAMBER, 7-HEAT EXCHANGERS, 8-FLUE GASES EXIT, 9-SECONDARY AIR

This project is a preparatory study and is not granted by external body but it is part of normal operation of University, however if the answer, to the mentioned above question, is positive it will create a base for projects granted from industry. This project is done exclusively by students. Students are expected to create geometry of the selected stoker boiler and perform series of simulations for different directions and amounts of secondary air. Calculations will be done using CFD code. First results are expected in June 2007. It is expected that within the project students will get familiar with application of CFD code for solving an industrial problems. Moreover they will get familiar with phenomena taking place inside the boiler.

Investigations of biomass derived syngas cofiring with coal

The EU directives force member states to increase share of renewable energy sources. In Poland the most promising and having highest potential, among other sorts of renewables, is biomass. Biomass can be co-fired with coal by mixing these two types of fuels. However in the Institute of Thermal Technology it was proposed to gasify biomass and introduce syngas to combustion chamber fuelled with coal. Such a solution allows to achieve better flexibility of process with respect to biomass type and parameters. Moreover syngas derived from biomass can be used as a reburning fuel reducing NO emission. The described idea is the clue of the project which was granted by Polish Ministry for Science

and Higher Education. In the frame of project laboratory scale stand for cofiring has been built and a series of laboratory measurements are expected to be performed. Student's role in this project is to participate in measurements and to make a calculations of mass and thermal balances of whole installation. Project is on-going and the laboratory tests haven't yet begun. It is expected that thanks to the project student will learn about complex chemistry phenomena occurring while gasification and reburning process.

Planting an energy crops

As it was already mentioned biomass is the most promising source of renewable energy in Poland. However profitability of biomass utilization depends strongly on the mass which can be collected from unit area. In the literature very different data can be found. For example for willow some authors claims mass efficiency less than 10 t per hectare annually, while others declare twice more. Polish Club of Ecology in Katowice [2] applied and was granted a project within which selected schools declared to plant and care for energy crops. The main task of this program is education of the society. However Silesian University of Technology has joined the program and extended it to identification of the influence of various factors (land quality, amount of water etc) on the mass collected annually from one hectare. Within the project students, on the designated part of land at the university, planted three different energy crops and now take care of them. In the future they will be supposed to compile data from all of schools taking part in the project and find out correlation between annual mass per hectare and mentioned factors. Expected effect of student participation in the project is that they will get familiar with energy crops and be conscious of the external factors influencing the effectiveness of their planting.

Clean coal technologies promotion

This project aims to promote and disseminate progress in the area of coal utilization. It is the European project granted by Research Foundation for Coal and Steel. Consortium consist of four partners – one from old EU-15 and three from new member states. The idea of the project is to disseminate results of projects carried out in EU to the new member states, which are main coal users in Europe. Two phases can be distinguished in the project. In the first of them by mean of questionnaires all main actors on coal market are asked series of questions answering which they express their situation, needs and challenges. In the second phase workshop is foreseen during which progress done in European projects will be presented. When writing this paper first phase is already finished while second is just started. Student, which is involved in this project had to process results of questionnaires and create one data base of Polish industry and R&D institutions. In the second phase the role of student will be administrative – in the conference office. The effect of the student participation in this project is that student will have an real picture of a current situation in the energy sector in Poland, as well as during the conference they will have occasion to discuss with their potential employers.

Design of a burner for raw rapeseed oil

Liquid fuels, substituting petroleum, can be obtained by biomass processing. Especially promising is rapeseed oil, which can substitute motor fuels. However raw rapeseed oil processing (estrification) needs a lot of energy, and therefore of special interest is usage raw unestrified rapeseed oil. The aim of the project was to design a burner which could operate both using fuel oil and mixtures of fuel oil with raw rapeseed oil. In the project it was decided to build two prototype burners and choose one of them for further improving and tests. The role of students was to design one of prototypes and take part in tests. In the first step two prototypes were tested using "cold tests" during which quality of atomization was estimated. Test stand is shown in Fig.4. It turn out that the design proposed by students is better than second one and was selected for further tests.

FIG.4 PHOTO OF THE TEST STAND FOR TESTING ATOMIZERS [3]

„Hot" tests were done in order to check performance of the designed burner while burning mixture of fuel oil with raw rapeseed. It was found that burner can be fuelled with mixture containing up to 50% of raw rapeseed oil. This project finished in 2005. The effect of student participation is that they learned by-doing how to design atomizer and had opportunity to see the effect of the design process.

Annual presentation of projects

As it was already mentioned, once a year seminar is organized during which students have opportunity of presenting the progress or results of their activities. Usually extra money is granted from sponsors for this event which allows to organize such event in leisure areas. Each project is presented by authors and than open for discussion and comments. Seminar is one week long. Except of presenting project seminar has also other goals. The first of them is to

allow better relations of academic teachers with students while informal discussions. The second task is to allow conversation of students with representatives of sponsors. During such a talks students may learn what are the expectations of future employers toward candidates, ask abut recruitment procedure and other issues. To create a atmosphere for such informal talks seminars are organized in such a ways that formal sessions take place from afternoon till early evening. In the mornings students have occasion to enjoy surrounding environment while in the evening there is an excellent opportunity for long talks. A photo from one of seminars is shown in Fig.5. The effect of student participation in this annual event is that they learn how to prepare and deliver the presentation on the task which they were supposed to complete.

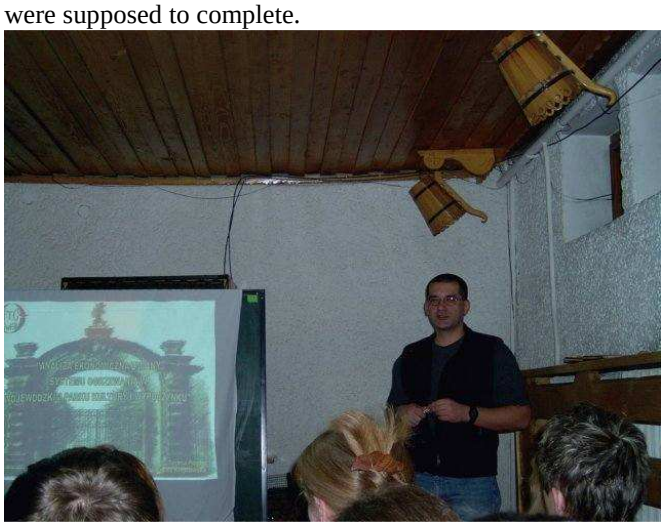

FIG.5 INTRODUCTION PERFORMED BY SUPERVISOR OF STUDENT SCIENTIFIC CLUB IN A FRONT OF PARTICIPANTS OF ANNUAL SEMINAR

Effects of the system

It can be noticed, that participation in the real industrial project is highly appreciated by the students. In general they willingly want to participate in a project and solve problems. Usually number of interested students exceeds number of offered positions in a projects. Moreover it was observed that students active in projects want to start PhD studies after graduating MSc. The quality of the work done by students is as a rule at good technical level. Thus it can be concluded, that involving students into projects allow to select group of active persons with scientific ambitions.

Problems encountered

In fact there are no many problems, but the main predominating one makes the system working not very efficiently. This problem is that the participation in the project is not a part of the student's obligations foreseen in a curriculum. Therefore students don't feel obliged to complete foreseen tasks to the given deadline. This pose a serious problems, since the deadlines of whole project, which students are participating in are the subject of contract signed by University and Third Body (granting the money) and can not be delayed. Therefore it happened that the tasks foreseen for students had to be completed by the staff of the Institute in order to fulfil the contract obligations. As a consequence some of project coordinators don't want to involve students treating them as untrusty workers.

Plans for the future

Described above system is very fruitful because of increasing quality of teaching process and because of selecting most active students, which than as a rule continue education with PhD studies. From the other hand mentioned problem with meeting the deadlines by students result in rather moderated interest from project coordinators in involving students. In the opinion of the author of this paper, the solution of this dilemma could be that part of work which is delegated to students should be not mandatory part of the contract, but some extra part which can be completed later on. The second solution is that some credit transfer points could be assigned for participation in the project and thus student would be obliged to complete the tasks within the deadline resulting from program of studies.

SUMMARY AND CONCLUSION

Presented aspects of involving students into research project results from recent few years. Till now it can be concluded that system is very successful in measures of student career and cv-building. However from the point of view of project supervisor in some cases involving students into this project resulted in necessity of completing the work by somebody else, which is obviously uncomfortable situation for project manager. In the opinion of the paper author it would be of great importance to remain system working. However risk of not meeting deadlines by students has to be reduced. This is a challenge for the nearest future.

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Adapted from paper template used for ICEE 2006.