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Occupational safety and health in eco-industry - part 3: comparison of knowledge level of selected workers in eco-industry in partner countries of THESEIS project

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Bezpečnost a ochrana zdraví při práci v eko-průmyslu - Část 3: Porovnání úrovně znalostí vybraných pracovníků eko-průmyslu v partnerských zemích projektu THESEIS

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Abstract

The last one of the articles dealing with results of THESEIS project (Training on Health & Safety for workers in the Environmental Industrial Sector) presents the results of surveys focused on spectrum and level of knowledge of eco-industry workers about specific risks related to their work. The survey in target groups „wastewater operator“ and „solid waste management“ was conducted in 8 partner countries of the project THESEIS.

Keywords: wastewater, waste, eco-industry, knowledge, skill, surveys, Czech Republic, Belgium, Bulgaria, Poland, Greece, Germany, Finland, Sweden

Abstrakt

Poslední z článků věnovaných výsledkům projektu THESEIS (Training on Health & Safety for workers in the Environmental Industrial Sector) předkládá výsledky průzkumu zaměřeného na spektrum a úroveň znalostí pracovníků eko-průmyslu o specifických rizicích souvisejících s jejich prací. Průzkum u cílové skupiny techniků odpadních vod a cílové skupiny odborníků na odpadové hospodářství byl proveden v osmi zemích partnerství projektu THESEIS.

Klíčová slova: vody odpadní, odpady, eko-průmysl, znalosti, dovednosti, průzkumy, Česká republika, Belgie, Bulharsko, Polsko, Řecko, Německo, Finsko, Švédsko

Introduction

In EU-25, the major eco-industry sectors in terms of turnover by far are water supply, waste water treatment and solid waste management (waste management and waste water treatment each represent approximately one third of the pollution management turnover). The total direct and indirect employment due to eco-industries represent approximately 3.4 million full-time job equivalents, of which 2.3 million jobs are from pollution management activities. Resource management activities represent approximately 1 million full-time job equivalents. The majority (77 %) of the jobs in the pollution management activities are in the waste water treatment and solid waste management sectors. [1]

The EU eco industry is besides other trends facing the demand for the new skills and a higher skill-level due to technical evolutions in the sector. Moreover the increasing public concern about hazardous substances, quality of water resources, contaminated sites, polluted air and the new legislation targeted at these concerns, enhances the need for improving workforce competencies. Therefore THESEIS project aims at developing an appropriate training for individuals working in the pollution management sector of eco-industry.

Different sources are used to determine the education concept of eco-industry workers and the actual content of the training model within the THESEIS project. One of these sources there are surveys carried out in partnership countries. In Greece, Belgium, Sweden, Finland, Germany, Czech Republic, Poland and Bulgaria two separated surveys were carried out in the first half of 2012:

- 1st survey: Identification of knowledge, skills and training needs of workers in eco-industry sector
- 2nd survey: Identification and documentation of National Qualifications Frameworks for workers in pollution management of eco-industry sector [a].

Both surveys were aimed at indentifying skills and training needs of employees whose work is directly related to ecology, environmental protection, waste management etc. and who are exposed to specific risks of water pollution due to industrial production. They were focused on two target groups: wastewater operators and waste management professionals.

This article brings description of the course and results of the 1st survey in Belgium, Bulgaria, Czech Republic, Finland, Germany, Greece, Poland and Sweden. **This article was focused only on the part of the survey investigating knowledge and skills of workers in eco-industry.**

Aims of the survey

The survey was focused on two target groups: wastewater operators and waste management professionals. The aim of the survey for the purpose "identification of knowledge and skills of workers in eco-industry sector"

which was carried out by partners of THESEIS project, was - according to the project aims – to collect all necessary data about knowledge and skills of employees at workplaces where pollutants from wastewater are disposed and in enterprises for treatment of wastewater arising from industrial production. The other target group was employees in solid waste treatment. In summary, these persons are in the THESEIS project and in this survey of knowledge and skills of workers in eco-industry known as “wastewater operators” and “waste management professionals”. The survey was carried in the middle of 2012. An individual questionnaire was developed for each target group in the pollution management sector (wastewater treatment and solid waste management).

If we compare the results of the surveys with the wishes of respondents for training in the other topics in Health and Safety Issues, we find consensus on the need (and a gap as well) of knowledge especially in these areas:

- Hazardous substances
- Use of personal protective equipment
- Fire safety
- Equipment Safety
- Risk assessment

The collected data and information can be considered as a valuable material for outcomes for identification of training needs and gaps in knowledge, skills and competences for experts on water and waste management.

The training model will be developed and implemented using a phased, extensively interactive collaborative approach incorporating early stakeholder involvement in the design of the learning outcomes and services, as well as utilizing graphic-oriented tools for the analysis and design stages for the production of vocational training material. The training model will use a web-based Virtual Community Platform (VCP) which will provide powerful and rich-on line information, multilingual interaction and networking and collaborative information publishing services among users. It is anticipated that the adaptation of the new innovative training model will generate several direct benefits (improve labour conditions, decrease risks and possibility of accidents) both for companies and workers operating in the eco-industry sector addressed. In addition it will empower companies and individuals to engage in true lifelong learning, career planning and evolution and encourage new entrants into the sector, ensuring healthier and safer working conditions as well as improved competencies and skills, thus facilitating the mobility of the eco-industry workforce.

Methodology

As a priority for the 1st survey an ordinary survey was selected. The survey was carried in the middle of 2012. An individual questionnaire was developed for each target group in the pollution management sector (wastewater treatment and solid waste management). Here you can see the questionnaire for target group “Wastewater operator”, here you can see the questionnaire for target group “Waste management professionals". The questionnaire was practically identical, only in the thematic area A.3 questions defined for waste management professionals concerned individual hazards and ergonomic, psychosocial and organizational factors were addressed directly to specific specialists: refuse collection workers, incinerator operators, land-fill operators. The project partners exploited their existing networks and their key positions in the market in order to disseminate extensively the survey questionnaire to a broad range of the targeted stakeholders’ group. The focus of individual THESEIS partners on the targets groups states **Table 1**.

country	acronym & colour in charts and tables	target group

Belgium	BE		waste management professionals
Bulgaria	BG		both target groups
Czech Republic	CZ		wastewater operator
Finland	FI		both target groups
Germany	DE		both target groups
Greece	GR		both target groups
Poland	PL		both target groups
Sweden	SE		both target groups

Table 1: Identification of 1st survey countries/partners

Workers occupied in eco-industry sector evaluated their knowledge and skills in the field of OSH with marks “excellent = 1, good = 2, average = 3, fair = 4, poor = 5 or not applicable answers (N/A)”.

Knowledge and skills of the respondents were identified in following thematic areas:

- **A.1 - Knowledge on the safety procedures or plans for company and project site**
- **A.2 - Guidelines for personal safety**
- **A.3 – Hazards**
  - **A.3.1 - Accident Hazards**
  - **A.3.2 - Physical Hazards**
  - **A.3.3 - Chemical Hazards**
  - **A.3.4 - Biological Hazards**
  - **A.3.5 - Ergonomic, Psychosocial and Organizational Factors**
- **A.4 - Safety guidelines for confined spaces**
  - **A.4.1 - Space entry permit**
  - **A.4.2 - Procedures for working in confined spaces**
- **A.5 - Guidelines for hazardous materials**
- **A.6 - Fire safety guidelines**.

Groups shown in bold were statistically evaluated and were then compared with each another. Received statistical data were evaluated and compared according to bold thematic areas. The comparison was made:

- separately in the target group WO
- separately in the target group WMP
- between the two target groups with each other.

Data received from individual countries were assessed statistically via arithmetical means achieved in individual thematic areas (A1 – A6) or for individual questions. The calculation includes only the answers to knowledge-based grades 1-5 or N/A. Not applicable answers (N/A) were not counted, since for determining the arithmetic mean is not possible to assign to the answer the corresponding value, which would have misinterpret the statistical calculation. The number of respondents whose answers were in the range 1-5, presents 100 % in the statistical processing.

For a more accurate evaluation of the level of knowledge and skills of individual waste management professionals (especially in the **thematic area A3 - Hazards**) **another methodolog**y was used. **Therefore the obtained data (number of responses) is expressed as a percentage so that each country is always represented with 100 % of the respondents and the comparison was as objective as possible.** Compared to the methodology used for overall evaluation and comparison (see above), we have not worked with the value N/A (not applicable), only with values expressing the level of knowledge (beside levels of knowledge “excellent, good, average, fair and poor”). When using this methodology 100 % represent all respondents who answered that particular question.

Results of the survey in participating countries

Results of the survey in participating countries

This article - because of limited extent - does not bring detailed results of the survey. For this reason, for example, we did not include an overview and analysis of respondents requirements on topics in which they feel the gaps or entirely new topics that they would consider necessary for their practice (see part B in both surveys), because they correspond with gaps indentified in part A. Detailed information about conducted survey is available in the Occupational Safety Research Institute (Výzkumný ústav bezpečnosti práce, v,v,i.).

The survey in both target groups encompassed **unequal number of respondents** from countries, which made the comparison difficult (we received 30 – 157 responses in the target group WO and 21 – 60 responses in the target group WMP.)

Unsuitable process of data collection by some partners and **different method** of preparation of documents (country reports) for processing the Synthesis report caused **some uncertainties**, which led to a **change in methodology** and **data analysis procedure** for comparing the knowledge and skills of the respondents in the partner countries.

Despite all these shortcomings the collected data and information can be considered as a valuable material for outcomes for identification of training needs and gaps in knowledge, skills and competences for experts on water and waste management.

TARGET GROUP: WASTEWATER OPERATOR

	BG	CZ	FI	DE	GR	PL	SE	**SPAN**
A.1	**4,00**	1,77	2,84	2,41	3,15	2,44	**1,50**	2,50
A.2	**3,65**	1,86	2,20	**1,58**	2,28	2,27	2,33	2,07
A.3.1	2,53	1,96	2,33	2,04	**2,58**	2,37	**1,93**	0,65
A.3.2	**3,05**	2,84	2,49	2,59	2,92	2,70	**2,00**	1,05

A.3.3	**3,12**	2,63	2,89	**2,48**	3,01	2,62	2,60	**0,64**
A.3.4	**3,65**	3,10	3,27	2,51	3,26	2,66	**1,67**	1,98
A.3.5	**3,24**	2,62	2,59	2,63	2,88	2,81	**1,67**	1,57
A.4.1	**4,76**	1,58	3,03	2,04	2,94	2,52	**1,00**	**3,76**
A.4.2	**4,52**	**1,60**	2,96	1,94	3,11	2,61	1,67	2,91
A.5	**4,63**	2,04	2,79	2,71	3,13	2,56	**1,00**	3,63
A.6	**4,37**	2,53	2,52	2,51	2,99	2,38	**1,00**	3,37

Table 2: Arithmetic means values in thematic areas - target group wastewater operator

Legend: The overview of arithmetical means shows the knowledge and skills of respondents in each partner country, which country has achieved the best average in groups A.1 – A.6 (green values) or, on the other side, which country has the worst average (red values) and which is the span between minimum and maximum. **The higher is the value (the number in the cell), the worse is the knowledge and skills of respondents.**

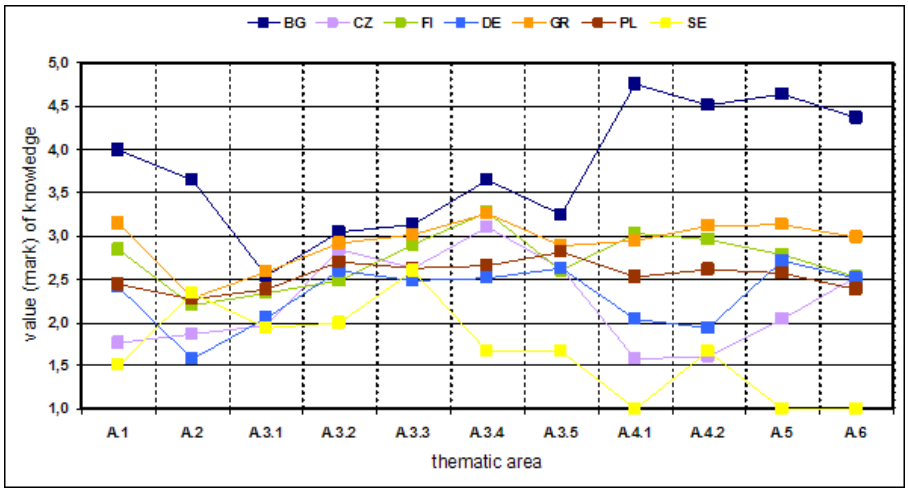

Chart 1: Knowledge level according to thematic areas - target group wastewater operator

Legend: On the vertical axis we can see the average value of knowledge achieved in each country which conducted a survey. **The higher the coloured small square is in relation to the vertical axis, the worse the knowledge and skills of respondents are.**

Based on stated level of knowledge and skills of wastewater operators, we have to define gaps in knowledge and skills. The question **“where are the gaps in knowledge and skills” can not be clearly answered** because there are big differences between the participating countries and the dispersion of the level of knowledge and skills in five thematic groups is greater or equal to value of 2.5.

We can speak clearly about gaps in knowledge and skills at an average higher than 3.0. Because it is not just one country in which the knowledge and skills were identified, it is preferable to adopt other criteria for determining acceptable knowledge. E.g., if we set the mean 2.5 as a boundary for acceptable knowledge, we see that practically all countries have the worst result in group of questions A.3.2 – A.3.5, i.e. **Physical Hazard, Chemical Hazard, Biological Hazard a Ergonomic, Psychosocial and Organizational Factors**. It is evident, that the largest gaps in knowledge and skills arising from this analysis are related to the group **A.3 - Hazards** where 6 out of 7 countries,

which conducted the survey, have the mean of less than 2.5 or something around this limit. **Poor results have been also showed in the groups:**

A.4.1 - Space entry permit

A.4.2 - Procedures for working in confined spaces

A.5 - Guidelines for hazardous materials

A.6 - Fire safety guidelines,

where higher values of the mean than 2,5 were reached by at least 4 countries – what is also an **overall majority.**

The results of the survey show that workers in wastewater sector have to be educated/trained in following areas and the requirements of the target group WO for more training in Safety and Health were also presented in these areas:

- **the work in confined spaces**, e.g. steps to do before entry permit, evacuation methods and systems in case of health or life at risk (notification and emergency systems, air quality test, risk assessment and hazard controls, emergency equipment needs, personal protection measures, lock-out and tag-out procedures, evacuation ways and facilities, evacuation coordinators, meeting places, etc.),
- **hazardous materials including relevant health protection** ,e.g. more information on specific harmful/dangerous substances - specific pollutants in the working environment and their effects on humans – that may occur in the process of waste or industrial water disposal, more information on relevant protection of workers, biological cleaning of the depot,
- **all hazards related with extreme working conditions** of wastewater operators (threats and their prevention at site-specific working post) basic safety measures and procedures, hazards during the maintenance including vapours in sewer cleaning (aerosols), hazards of working with polymer powder (dust), the acquaintance with guidelines for use and handling of hazardous materials (MSDS),
- **fire prevention and fire-fighting systems**,
- **explosion risks and explosion prevention**, especially explosion protection of digester gas systems.

TARGET GROUP: WASTE MANAGEMENT PROFESSIONALS

Target group WMP included these professions: refuse collection workers, incinerator operators and land-fill operators.

	BE	BG	FI	DE	GR	PL	SE	**SPAN**
A.1	1,86	3,27	2,10	2,39	**3,29**	2,11	**1,83**	1,46
A.2	1,92	**3,90**	2,04	**1,72**	2,54	2,29	1,78	2,18
A.3.1.1	2,07	**3,27**	2,15	2,03	2,96	2,53	**1,32**	1,94
A.3.1.2	2,38	**3,25**	2,11	2,00		2,56	**1,43**	1,81
A.3.1.3		**3,35**	2,05	1,91	2,85	2,50	**1,13**	2,23
A.3.2.1	2,71	**3,11**	2,29	2,38	2,79	2,56	**2,22**	0,89
A.3.2.2	2,60	**3,28**	2,00	**1,83**		2,35	2,17	1,45

A.3.2.3		**3,23**	2,15	**1,67**	3,12	2,26	2,31	1,56
A.3.3.1	3,14	**3,61**	2,45	2,70	3,29	3,16	**1,85**	1,76
A.3.3.2	2,83	2,95	2,00	2,20		**3,03**	**1,84**	1,19
A.3.3.3		3,47	2,36	2,55	**3,63**	3,09	**1,93**	1,71
A.3.4.1	3,28	3,85	2,51	2,85	**3,87**	3,06	**1,50**	2,37
A.3.4.2	3,06	**3,54**	2,00	2,25		3,07	**1,33**	2,21
A.3.4.3		**3,76**	2,31	2,47	3,37	2,94	**1,52**	2,24
A.3.5.1	2,39	2,41	**2,16**	2,36	**3,09**	2,72	2,57	0,93
A.3.5.2	**2,78**	2,50	**2,00**	2,27		2,33	2,55	**0,78**
A.3.5.3		3,04	2,17	**1,95**	**3,25**	2,46	2,61	1,30
A.4.1	2,78	**3,67**	2,50	2,77	3,60	2,76	**1,12**	**2,55**
A.5	2,52	**3,83**	2,63	2,53	3,44	2,65	**1,77**	2,06
A.6	**2,46**	**4,05**	2,71	2,51	3,19	**2,46**	2,61	1,59

Table 3: Values of arithmetic means in thematic areas - target group waste management professionals

Legend: The overview of arithmetical means shows the knowledge and skills of respondents in each partner country, which country has achieved the best average in groups A.1 – A.6 (green values) or, on the other side, which country has the worst average (red values) and which is the span between minimum and maximum. **The higher is the value (the number in the cell), the worse is the knowledge and skills of respondents.**

Some fields are empty because the Czech Republic worked with the target group WO only and Belgium with the target group WMP only (see Table 1).

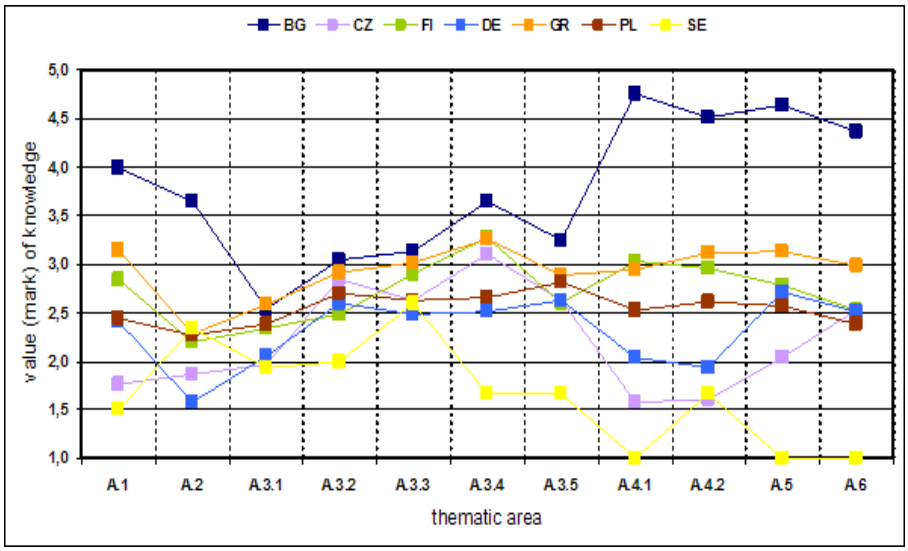

Chart 2: Knowledge level according to thematic areas - target group waste management professionals

Legend: On the vertical axis we can see the average value of knowledge achieved in each country which conducted a survey. **The higher the coloured small square is in relation to the vertical axis, the worse the knowledge and skills of respondents are.** The column A.4.2 does not show any results because knowledge and skills (question 4.2 – “Comply with procedures for working in confined spaces”) were not inquired in the target group of waste management professionals.

Based on stated level of knowledge and skills of waste management professionals, we have to define gaps in knowledge and skills. **In the field of gaps in knowledge and skills of waste management professionals there is not such dispersal of the level of knowledge - such noticeable in the target group of wastewater operators.** Nevertheless, there are considerable differences in knowledge in participating countries.

We can speak clearly about gaps in knowledge and skills at an average higher than 3.0. If we set as a threshold for acceptable knowledge (analogous to target group wastewater operator) arithmetical mean 2,5, we find that bad or not very good knowledge is showed in following thematic areas and professions (see **Table 4** and **Table 5**):

	profession	**number of country**
A.6 - Fire safety guidelines	all WMP	6
A. 4.1 Safety guidelines for confined spaces	all WMP	5 countries + 1 country beyond the mean of 2,5
A. 5 - Guidelines for hazardous materials	all WMP	5 countries + 1 country very close to the mean of 2,5
A.3.2 - Physical Hazards	refuse collection workers	4
A.3.3 - Chemical Hazards	land-fill operators	4
A.3.5 - Ergonomic, Psychosocial and Organizational Factors	refuse collection workers	4

Table 4: Areas with the worse knowledge and skills – 4 and more countries
(WMP = waste management professionals)

	profession	**number of country**
A.3.1 Accident Hazards	land-fill operators	3 countries + 1 country on the edge of the mean of 2,5
A.3.4 - Biological Hazards	land-fill operators	3 countries + 1 country very close to the mean of 2,5

Table 5: Areas with the worse knowledge and skills – less than 4

From **Table 4** and **Table 5** is evident that considerable gaps in knowledge and skills are showed by everyone from **WMP** in the field of **Safety guidelines for confined spaces, Guidelines for hazardous materials a Fire safety guidelines. Larger or smaller gaps in knowledge and skills are related to the whole group A.3 - Hazards –** and mostly to **refuse collection workers and land-fill operators**.

According to the boundaries of acceptable knowledge set in this report, the need for learning for **waste management professionals** can be seen **in areas where most of the 7 participating countries achieved worse mean than 2,5**. In the profession of land-fill operator we must take into account that 1 country (Belgium) was not included in the survey, so the arithmetic mean listed in **Table 5** is related only to 6 countries. This means that respondents from more than half of the participating countries **have poor knowledge** in groups **Accident Hazards and Biological hazards.**

The results of the survey show that workers in solid waste sector have to be educated/trained in following areas and the requirements of the target group WO for more training in Safety and Health were also presented in these areas:

- **the work in confined space** (entry permit, procedures for confined spaces),
- **hazardous material, including relevant health protection** (protection against physical, biological and chemical contamination including proper use of PPE),
- **all hazards related with extreme working conditions of wastewater operators** (threats and their prevention at site-specific working post) **and hazardous materials,**
- **fire safety/prevention and fire-fighting systems,**
- **explosion risks and explosion prevention,**
- **appropriate health protection** arising from risks, working environment and conditions for **solid waste management.**

In the field of gaps in knowledge and skills of waste management professionals **there is not such a dispersion of the level of knowledge - such noticeable in the target group of wastewater operators. And the areas where more training is required are quite similar to the target group “Wastewater operator”.**

Conclusion

Common requirements for both target groups

If we compare the results of the survey with the wishes of respondents for training in the other topics in Health and Safety Issues, we find consensus on the need (and a gap as well) of knowledge in following areas / The results of the survey show that **workers in wastewater sector have to be educated/trained in following areas:**

- **Hazardous substances**
- **Use of personal protective equipment**
- **Fire safety**
- **Equipment Safety**
- **Risk assessment**
- **Environmental protection**

The above recommendation for content of VET program shall apply to persons who are to be trained/further educated (trainees), not to trainers.

Within **THESEIS project** now – based on above mentioned results of the surveys - an **innovative training model** in the field of **Occupational Health and Safety (OHS)** for the **workers occupied in the pollution management sector of eco-industry**

will be developed, tested, validated and disseminated..

THESEIS instructional strategy is anticipated to create a learning culture on OHS aspects according to learner needs where collaborative learning with multiple perspectives and self-management will be promoted.

It is foreseen that the high demand of professionals in the fields of OHS and the pollution management sector of the eco-industry, the priorities of the E.U. policies towards sustainable development and green economy combined to the collaborative and networking character of THESEIS project, to lead to at a high level the demand for the THESEIS project results and outcomes in a medium and long term perspective.

Finally, as green and sustainable practices become more common in Europe and also in other parts of the world, there is an opportunity to promote worker safety and health as a fundamental dimension of true sustainability. A sustainable product, process or technology should not only protect the environment and the consumer but also the worker. Green jobs must be safe jobs and eco-industry can show the way to that.

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