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PRACTICAL APPLICATION OF CLEANER PRODUCTION IN SMALL SIZED ENTERPRISE

Abstract: *The paper provides short introduction of cleaner production as very effective tool of environmental performance improvement. Cleaner production is focused to prevention, which means to reduction of amount and toxicity of waste directly in its source, effective use of energy, materials and raw materials, which leads to their saving and reducing production and operating costs. Principles of cleaner production are applicable in any industry sector, in company of any size and location. Authors demonstrate, that these principles can be applied in small sized enterprise and advantages of its application are significant both from environmental and economical point of view.*
Keywords: *cleaner production, environmental efficiency, small sized enterprise*

1. INTRODUCTION

Industry factories together with scientists developed various methods and workflows for reaching eco-efficiency. One of most widely used is implementation of environmental management system (according to ISO 14001 or EMAS), which ensures integration of environmental protection into global management of an enterprise. Implementation of these tools requires high financial, administrative and personal demands. Small and medium sized enterprises often do not own sources for implementing such system. Not only large enterprises, also small and medium size enterprises want to show their responsibility to environment. Exactly for those, other voluntary and less formal tools for improving environmental behavior were developed. One of these tools is cleaner production.

Cleaner production is often marked as sustainable implementation of integral preventive strategy of processes, goods and services, with the goal of increasing their effectiveness and limits the risk of human health and environment. By production processes, cleaner production includes more effective usage of materials and energy, exclusion or limitation of toxic or hazardous materials, prevention of waste generation and sources of pollution, and so limitation of natural, material and energetic sources. By the products (articles and services) the strategy of cleaner production concentrates on the decrease environmental impact, including the whole life cycle. [6]

Generally, cleaner production is a strategy which introduces new systematical approach to decreasing or even exclusion of environmental pollution. It was established in developed countries and is based on prevention of pollution directly by the source. It means, it concentrates on the pollution prevention rather than waste disposal. Cleaner production as a tool means to implement the prevention in the praxis in specific project. Cleaner production brings positive

change to the view at pollution. It means, traditional approach understands waste as "necessary evil", charge for production that has to be paid. Whereas, from the point of view of cleaner production, every waste represents expensive materials and energy which were not transformed to the product and which require further expenses for disposal. Cleaner production considers as pollution all waste, emissions, waste water, all solid, liquid and aerosol substances, which pollute air, water or soil, then noise, waste thermal energy or other forms of waste energy (e. g. pressed air etc.).

The goal of cleaner production is the prevention of waste generation by better, more effective usage of incoming materials and energy. It has of course remarkable economical effect in the way of decreasing production expenses, which increases efficiency and competition ability of an enterprise. [7] Some of the principles of cleaner production were implemented in the following project – ecologization of small enterprise – drug store. Partial results of this project are presented within this article.

2. THE PROJECT OF CLEANER PRODUCTION IMPLEMENTATION–CASE STUDY

2.1 Enterprise description

The pharmacy "U raka" is situated in the Bardejov district. Its activity is carried out in the medical complex, Sekčovská 26/1 street, in the village Raslavice. The main scope is to provide pharmaceutical care in a public drug store. It provides following services: medicine merchandising, individually prepared medical preparations, medicine for prescription, individual preparation of creams, lotions for per oral and external use, powders according to special formulas, merchandising of medical materials (bandages, gauze, plasters, diabetic aid), individual orders of medicines according to the patient's needs, providing of information about medicines registered in Slovakia. The drug store has 4 employees and therefore it can be categorized as micro-company, which usually has less than 10 employees.

2.2 Current condition of the drug store

The drug store carries out its business in an older building of the medical complex. The building has not been insulated. Doors and windows are old and seals do not work as they should. The drug store is heated by an old type of atmospheric furnace boiler, which is quite energy consuming. Cooling equipment is within the A-class of energy efficiency. For lighting the energy saving fluorescent lamps are used. An electric boiler is used as the source of hot water. According to the building certification, the drug store was categorized as F-class – highly energy demanding. For this reason we focused the project on improving of energy balance of the drug store. The plan and 3D model is showed in figures 1 and 2 respectively.

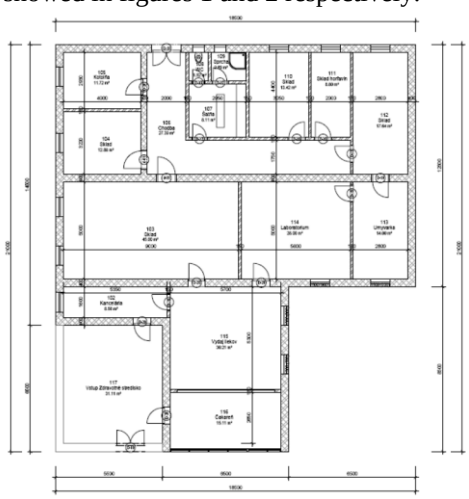

Figure 1 - Plan view of the drug store

Figure 2 – 3D view of the drug store

2.3 The project of energetic, economic and environmental effectiveness of a company

For improvement of energetic, economic and environmental effectiveness of the drug store we suggest following:

1) Exchange of old exterior windows and doors for new, plastic windows and doors and insulation of outer walls.
2) Exchange of the old furnace boiler for new condensation boiler.
3) Installation of solar collector for obtaining hot water.

2.3.1 Exchange of old exterior windows and doors for new, plastic windows and doors and insulation of outer walls

The object requires insulation from the north and west, which is approx. 80 m^2. Estimated expenses are 10 €/m^2, so total it would be 800 €. 14 windows, 1 door and a glass wall need to be replaced. Estimated expenses are shown in table 1.

Table 1 - Estimated expenses for new windows and door

	Number	Size [mm]	Unit price in EUR	Total price
Window	12	1000x1500	200	2400
Window	2	600x900	100	200
Door	1	1800x2000	331	331
Glass wall	1	5400x2800	584	584
				3 515 EUR

Total estimated budget for insulation and door and windows replacement is 4 315 €. Table 2 shows expenses for gas consumption before insulation and windows and doors replacement.

Table 2 - Expenses for gas consumption before insulation

atmospheric stationary boiler – before insulation Gas consumption	43 535 kWh/year
Price per 1 kW of gas	0,0489 €/kWh
Total price of gas	2 128,86 €/year

Table 3 shows expenses for gas consumption after insulation and windows and doors replacement. Expenses decreased of 627 €.

Table 3 - Expenses for gas consumption after insulation

atmospheric stationary boiler – after insulation Gas consumption	30 712 kWh/year
Price per 1 kW of gas	0,0489 €/kWh
Total price of gas	1 501,82 €/year

Figure 3 shows return of investments for

insulation in years. The chart results that the investments will return within 6 years, in the 7th year the company will report profit. The profit in the 10th year will reach 1955 €.

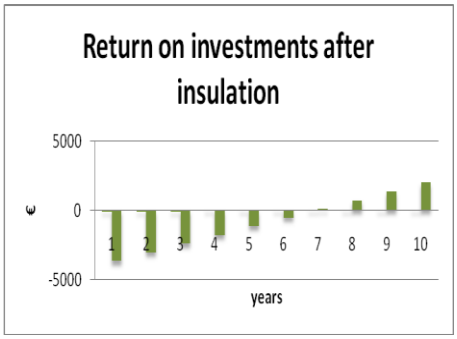

Figure 3 - Return of investments after insulation (in years)

2.3.2 Replacement of the old furnace boiler for new condensation boiler.

Estimated costs of replacement are 995 €. The cost of gas consumption is reduced by 153 € per year, as is showed in table 4.

Table 4 - Comparison of gas consumption after the replacement of boiler

atmospheric stationary boiler – after insulation Gas consumption	 30 712 kWh/year
Price per 1 kW of gas	0,0489 €/kWh
Total price of gas Condensation boiler – new state	1 501,82 €/year
Gas consumption	27 578 kWh/year
Price per 1 kW of gas	0,0489 €/kWh
Total price of gas	1 348,56 €/year

If we expect the annual savings of 153 €, return of investments will be in 6 years, which is shown on fig. 4. In the tenth year of the use of a new boiler we can expect profit € 535.

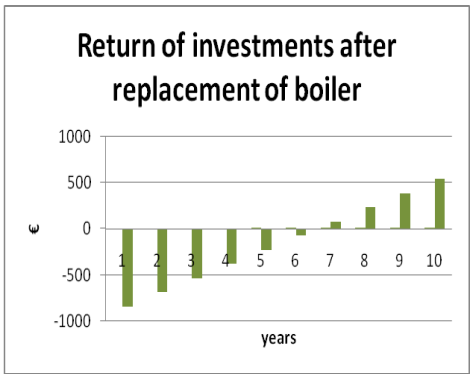

Figure 4 - Return of investments after replacement of boiler (in years)

2.3.3 Installation of solar collector for water heating

Estimated expenses for purchasing the solar collector is 1991 €. Solar collector will serve mainly for hater heating. The cost of gas consumption after application of solar collector is reduced by approximately 170 € per year, as is showed in table 5.

Table 5 - Annual gas consumption after the application of solar collector

condensation boiler + solar collector Gas consumption	 24 089 kWh/year
Price per 1 kW of gas	0,0489 €/kWh
Total price of gas	1 177,95 €/year

Return of the investment of solar collector application is estimated to 11 years. Operating life of solar collectors is estimated to 15 years. In terms of return of investment the application of solar collector is not effective.

Table 6 as well as figure 5 demonstrate the comparison of annual gas consumption of each proposed action.

Table 6 - Comparison of annual gas consumption of particular suggestions in EUR

atmospheric stationary boiler – before insulation	2 129 €/year
atmospheric stationary boiler – after insulation	1 502 €/year
condensation boiler	1 349 €/year
condensation boiler + solar collector	1 178 €/year

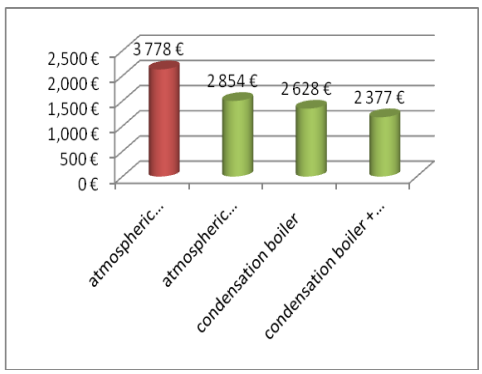

Figure 5 - Comparison of annual gas consumption of particular suggestions in EUR

Figure 6 shows a comparison of the effectiveness of return on investment for each proposed action. The graph shows that the most effective measure is no. 1 - building insulation and replacement windows and doors and the least effective is measure no. 3 – application of a solar system for hot water.

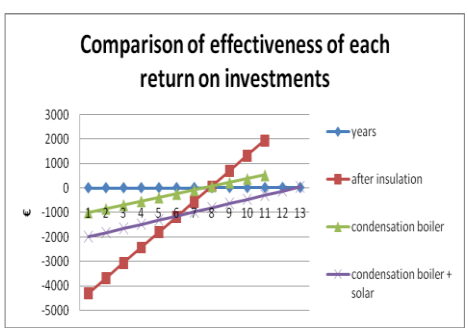

Figure 6 - Comparison of effectiveness of each return on investments

CO_2 production of each suggested action

In addition to return on investment, however, we are interested in the impact of investment on the environment. Figure 7 shows CO_2 production of a company in each of the proposed solutions. The figure shows that company will have the lowest production of CO_2 in the use of condensing boilers and solar collector.

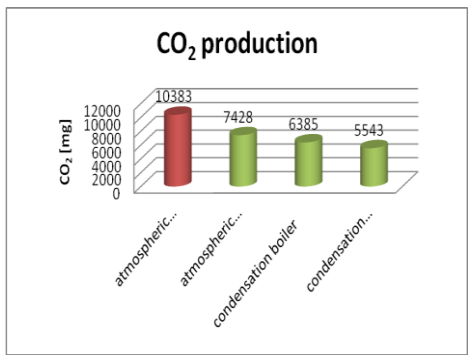

Figure 7 - CO_2 production

After implementing the proposed measures the pharmacy will be ranked in the energy range of C, which is in terms of suitable building heat consumption.

3. CONCLUSION

Analysis of present state of energetic source management of the pharmacy is not effective. Therefore, we suggest measures to help reduce energy costs as well as the impact on the environment. These measures were assessed and compared to each other considering return on investment and CO_2 production. Based on these criteria, we recommend realizing measure no. 1 - Exchange of old exterior windows and doors for new, plastic windows and doors and insulation of outer walls and also measure no. 2 - Exchange of the old furnace boiler for new condensation boiler. After application of these measures we estimate the return on investments up to 6 years and saving of financial resources to 1407 € per annum. This investment brings not only economical advantage but also

environmental one, because reduces the production of CO_2 compared to the original state of almost half of the original 10 383 mg to 5 543 mg. Implementation of the principles of cleaner production in the pharmacy "U Raka" will present the benefits of lowering operating costs on the one hand and reducing CO_2 emissions production on the other. We believe that simple principles of cleaner production can bring the win–win effect – the benefits on economical and environmental side, for every organization.

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