

## **CLEAN PRODUCTION APPROACH IN FOREST PRODUCTS INDUSTRY; DÜZCE CITY EXAMPLE (TURKEY)**

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### **Abstract**

*The businesses turn towards environment friendly production technologies as people are becoming more sensitive about preventing environmental pollution and protecting the natural resources. Accordingly, businesses have adopted strategies for protecting the environment and efficient consumption of natural resources by using the raw material more effectively, and clean production approach has started to take its place in their production policies. This study aims exploring the cleaner production approach, used for increasing environmental sensitivity, based on the forest products industrial businesses in Düzce city, which has an important place in Turkey in terms of forest products industry. Survey method is used as the data collection method in this study for this purpose. The current status of forest industry businesses, energy types they use in production, evaluation of wastes, and practices and policies on environmental sensitivity are examined with the survey forms prepared. After considering the current status of the Düzce forest products industry as a result of the study, it's been determined that it is required to consider environment and production process together for placing clean production approach into the industry.*

**Key words:** forest products industry; clean production; Düzce; Turkey.

### **INTRODUCTION**

Today, the environmental problems are on top of the agenda of both Turkey and the world. The rapid increase in the global population, as well as in the production and consumption activities particularly after the industrial revolution has caused the environment to be polluted, and natural resources to reduce and extinct by time in a way threatening the future of the world (Sencar 2007). The first thing coming into mind about environmental pollution is air pollution, water pollution, soil pollution, waste related pollution, visual pollution, and noise pollution (Karacan 2002).

The environmental pollutions caused by enterprises in all scale inside the cities and surrounding can be listed as industrial air pollution, industrial waste water, industrial solid wastes, and noise pollution. Industrial air pollution is very closely related with the increase in the use of energy in industry and the development of heavy industry (Karacan 2002).

The developing industry sector in Turkey causes environmental problem. The utmost factor in the environmental problems is failing in selecting a sound location and enabling the units for disposing the wastes arising in the sector (Directorate of Provincial Environment and Forest 2008).

The pollution caused by the industry arises from the deficiencies in investment planning and location selection, rather than the size of the investments. Industrialization uses productive agricultural

lands as a site of establishment on one hand, and various wastes coming out from these facilities may cause problems such as air, water, soil, noise and radiation pollution etc. on the other hand (Tanrivermiş and Mülayim 1999).

The efforts for finding solutions to the environmental problems have brought various responsibilities. Responsibilities of the industry include determining the consumer demands, following up the global market, complying with national and international environmental and production related legislation, applying and researching environment friendly production techniques such as clean production, all within the scope of sustainable development principles. (Sevim Korkut and Karadağ 2010).

Clean production is an environment friendly production approach aiming to use raw material and energy less, increase reuse and recycling, create less waste, and reduce the amount of hazardous waste. Therefore, it aims minimizing the environmental impacts arising from production by preventing/reducing the formation of waste at its source, and plays an important role in increasing the business efficiency and preventing the environmental pollution (Sevim Korkut and Karadağ 2010). Clean production can be applied for small and big scale enterprises regardless from the levels of their material, energy and water consumption (TTGV 2011). In order to realize clean production applications in the enterprises, it should be ensured that the personnel of the enterprise in every level contribute to the solution of the problems. Clean production applications should raise an awareness for the employees and make the applications a part of the daily operation (Karadağ and Sevim Korkut 2012). In addition to this; policies on topics such as clean production which fall into the scope of environment friendly production and damage the environment less while increasing the efficiency should be developed and adopted in order to improve the implementation of clean production and applications countrywide (Altınışik Dirik and Akyol 2007).

## **OBJECTIVE**

This study aims exploring the cleaner production approach, used for increasing environmental sensitivity, based on the forest products industrial businesses in Düzce city, which has an important place in Turkey in terms of forest products industry.

## **MATERIAL, METHOD**

Forestry products industry is one of the important branches of industry in Turkey. Forest products enterprises represent nearly 22,3% of the total manufacturing industry, and employee portion is nearly 11,5% of all the employees in Turkey (Akyüz et al. 2010). Forestry products industry in the city of Düzce represents a share of 32,6% (Gültekin et al. 2009). High rate of forest land and developed transportation system, which is vital for industry, are among the reasons for this situation (Sevim Korkut and Karadağ, 2010). Questionnaire technique is used in the study for collecting data. For this purpose, the questionnaire is applied to 30 forestry products industry businesses operating in the city of Düzce. The questionnaire is prepared by using the studies in the literature (Sevim Korkut and Karadağ 2010; Karadağ and Sevim Korkut 2012), and is consisted of two sections including the current situation of the enterprises and a review on the clean production process. The data collected is assessed in the statistics package software (SPSS).

## **LIMITS OF STUDY**

The study is based on the forest products industry enterprises operating in the city of Düzce. The considered in the study are limited based on these businesses.

## **RESULTS AND DISCUSSION**

### **Current Status of the Enterprises**

In this section, the study tries to determine various situations including the establishment dates of the enterprises, the outdoor and indoor production areas they have, their production and capacity status, and their operational activities.

### ***Establishment Dates of the Enterprises***

The establishment date of the enterprises goes back to 1960s. It's been determined that one of the enterprises included to the study was established in 1968. As it can be seen from the Table 1, when an evaluation is made for a period of 10 years, it's been determined that 3,3% of the enterprises were established between 1960 and 1969, while 6,7% between 1970 and 1979, 16,7% between 1980 and 1989, 40% between 1990 and 1999, and 26,6% between 2000 and 2009. There is no factory established in 2010 and after.

**Table 1**

**Establishment dates of the enterprises**

Options	Frequency	%
1960-1969	1	3,3
1970-1979	2	6,7
1980-1989	5	16,7
1990-1999	12	40
2000-2009	8	26,6
2010 and over	-	-
No response	2	6,7
Total	30	100

**Outdoor and Indoor Production Areas of the Enterprises**

Considering the outdoor areas of the enterprises, it's been determined that there is no enterprise with an outdoor area of less than 1.000 m<sup>2</sup>. In addition to this, it's been determined that 53,2% of the enterprises have an outdoor area of 10.000 m<sup>2</sup> and more (Table 2). Considering the indoor areas of the enterprises, it's been determined that the majority of the enterprises (26,6%) have an indoor area of 10.000 m<sup>2</sup> and more (Table 2).

**Table 2**

**Outdoor and indoor production areas of the enterprises**

Options	Outdoor area [Frequency]	Outdoor area [%]	Indoor area [Frequency]	Indoor area [%]
less than 1.000 m <sup>2</sup>	-	-	1	3,3
1000-1499 m <sup>2</sup>	2	6,7	1	3,3
1500-1999 m <sup>2</sup>	-	-	2	6,7
2000-2999 m <sup>2</sup>	1	3,3	5	16,7
3000-3999 m <sup>2</sup>	3	10,0	-	-
4000-4999 m <sup>2</sup>	3	10,0	5	16,7
5000-5999 m <sup>2</sup>	-	-	3	10,0
6000-9999 m <sup>2</sup>	1	3,3	2	6,7
10000 m <sup>2</sup> and over	16	53,2	8	26,6
No response	4	13,4	3	10,0
Total	30	100	30	100

**Legal Structure of the Enterprises**

According to the data providing information about the legal structure of the enterprises, the enterprises responding to the questionnaire are listed as 36,7% Joint Stock Company, 33,3% Limited Company, 10% Sole Proprietorship, 3,3% Open Partnership, and 3,3% Legal Entity.

**Employee Status of the Enterprises**

The employees of the enterprises are reviewed in three categories including the number of workers (Table 3), and of administrative and technical personnel (Table 4).

While the number of employees is between 50 and 99 in 23,3% of the enterprises, the number of employees is 100 and more in 16,7% of the enterprises.

Considering the number of technical and administrative personnel of the enterprises, it's been determined that 26,6% of the enterprises have 5 and more technical employee, and 49,9% have 5 and more administrative employees.

**Table 3**

**The number of workers working in the enterprises**

The groups of workers number	The number of workers	
	Frequency	(%)
1-9 person	5	16,7
10-19 person	5	16,7
20-29 person	3	9,9
30-39 person	2	6,7
40-49 person	2	6,7
50-99 person	7	23,3
100 person and over	5	16,7
No response	1	3,3
Total	30	100

**Table 4**

**The number of technical and directory workers**

The groups of workers number	Technical worker		Administrative worker	
	Frequency	%	Frequency	%
No worker	5	16,7	1	3,3
1 person	4	13,3	4	13,3
2 person	7	23,4	3	10,0
3 person	5	16,7	5	16,7
4 person	1	3,3	2	6,8
5 person and over	8	26,6	15	49,9
Total	30	100	30	100

**Production Method of the Enterprises**

36,7% of the enterprises did not provide an answer for the question "What method do you use for production?" 20% of the enterprises responding to this question stated that they carry out mass production, while 30% carry out order production, 3,3% carry out both mass and order production, 3,3% carry out manufacturing, and 3,3% carry out lean production.

**Capacity Utilization in The Enterprises**

It's been determined that 16,7% of the enterprises operate in full capacity, while 76,7% do not. The capacity utilization rate in 26,7% of the enterprises is 60-79% (Table 5).

**Table 5**

**Capacity utilization condition**

Main Factors	Options	%
Capacity utilization condition	We are not working at full capacity	76,7
	We are working full capacity	16,7
	No response	6,6
	Total	100.0
The rates of capacity utilization (%)	1-19	-
	20-39	6,6
	40-59	20
	60-79	26,7
	80-99	16,7
	No response	30,0
	Total	100

**Type of Products Produced by The Enterprises**

The types of products produced by the enterprises are determined as wooden paneling, timber, laminated wood, parquet, separation wall, hostess cabinet, climbing ramp, seat bottom, wedge, palette, bathroom furniture, cabinet and decoration products, joinery, coated panel door, project works, manufacturing of wood drying machines, wainscot, method, massive panel, laminated parquet, table, chair, kitchen furniture, corner couches, MDF, MDF chipboard, melamine coated chipboard, plywood, furniture, and school furniture.

**Recycling Products of The Enterprises**

It's been determined that 13,3% of the business have recycle products, while 83,3% do not have.

**Review on The Clean Production Process in the Enterprises**

**Types of Energy Used by The Enterprises in Production**

The enterprises prefer electricity (93,3%) more as the type of energy. The less preferred type of energy is natural gas (3,3%) (Table 6). Under the option "Other", the enterprises stated that they use wood powder as a type of energy.

**Table 6**

**Types of energy used by the enterprises**

Options	N	%
Electricity	28	93,3
Natural gas	1	3,3
Coal	5	16,7
Wood	15	50
Other	3	9,9

**Water Resources Used by the Enterprises**

63,3% (N=19) of the enterprises prefer well water, while 43,3% (N=13) prefer municipal water. 6,7% (N=2) of the enterprises stated that they prefer other water resources.

**Types of Wastes Produced by the Enterprises**

The waste products produced by the enterprises as a result of their production are determined as 70% (N=21) solid, 26,6% (N=8) liquid, and 6,7% (N=2) gas (Table 7).

**Table 7**

**Types of wastes produced by the enterprises**

Types of Wastes	N	%
Solid	21	70
Liquid	8	26,6
Gas	2	6,7

Solid wastes are determined as wood, iron, steel, packaging material cardboard, scrap material, waste MDF, chipboard, timber, coating, shaving, log parts, timber wastes, parts coming out from manufacturing, cut tree products, ash, chips, and nylon.

It's been determined that the solid wastes are stored at the waste landfill, disposed to the municipal dump site, cleaned by the environmental cleaning company, given to the recycling companies for recycling, sold as a scrap, incinerated in boilers, shavings are stored in the silos through dedusting system, stored in wood and shaving warehouses, and in hazardous solid waste storage tanks.

Liquid wastes are determined as waste glue, polishing line, aqueous system waste water, field irrigation, and steaming boiler water. It's been stated that the liquid wastes are cleaned and delivered to the sewer system, and stored in hazardous liquid waste tanks.

Gas waste types are found out to be gases coming out from the chimney.

**Applications on Environment Friendliness**

5 of the enterprises (16,7%) stated that they have a wastewater treatment facility, while 15 of them (50%) have filter system, 2 of them (6,7%) have recycling facility, and 18 of them (60%) have dedusting system (Table 8).

**Table 8**

**Applications on environment friendliness**

Options		Frequency	%
Do you have a wastewater treatment facility?	Yes	5	16,7
	No	25	83,3
Do you have a filter system?	Yes	15	50
	No	15	50
Do you have a recycling facility?	Yes	2	6,7
	No	28	93,3
Do you have a dedusting system?	Yes	18	60
	No	12	40

**Reasons for the Enterprises to Apply Clean Production**

The enterprises provided the reason why they apply clean production as “reducing the energy costs, reducing the environmental pollution, reducing the raw material costs, increasing competitiveness, and observing the laws”.

**Ideas of the Enterprises about Environment Friendliness of the Forestry Products Industry**

The ideas of the enterprises about environment friendliness of the forestry products industry are provided as follows.

- Environment friendliness rapidly progresses due to the environmental law, frequency of inspections, and high amount of fines. The highest priority is considered for minimizing the polluting of the environment while carrying out the production activities.
- Using the nature as its resource, this industry should feel itself responsibility for showing the highest sensitivity to the nature. However, the industry does not act environment friendly although it has advantages in terms of their establishment structure and the resources used. In this industry, where the chemicals (glue, paint, thinner, varnish etc.) are highly used, there is a need for development and sensitivity about the methods on using, storing and disposing the chemicals.
- There is less damage caused to the environment compared to the other industries (except paper and sheet).
- They try to act more environment friendly and as a whole compared to the other industries.

**CONCLUSIONS**

The establishment date of the enterprises goes back to 1960s. Considering the outdoor areas of the enterprises, it's been determined that there is no enterprise with an outdoor area of less than 1000 m<sup>2</sup>, and 53,2% of the enterprises have an outdoor area of 10.000 m<sup>2</sup> and more. Considering the indoor areas of the enterprises, it's been determined that the majority of the enterprises (26,6%) have an indoor area of 10.000 m<sup>2</sup> and more.

The number of permanent employees of 16,7% of the enterprises is 100 and more. Considering the number of employees, they have a significant share for the employment in the city of Düzce. 26,6% of the enterprises employ 5 and more technical employees, while 49,9% of them employ administrative employees.

It's been determined that 16,7% of the enterprises operate in full capacity, while 76,7% do not. The capacity utilization rate in 26,7% of the enterprises is 60-79%.

It's been determined that 13,3% of the enterprises have recycle products, while 83,3% do not have. In the study of Demirkır and Çolak (2006), it's been stated that establishing a recycling center for using the wood wastes would provide a solution for planning the sourcing, quality and disposing the wood wastes.

The enterprises use municipal water and well water as their water resource. 15 of the enterprises have water well. It's been determined that 3 of the enterprises with a water well have water well registration certificate. The enterprises stated that they use the well water for cleaning, garden, and production processes.

The businesses prefer electricity (93,3%) more as the type of energy. The less preferred type of energy is natural gas (3,3%). It's seen that the enterprises do not have any initiative related to the renewable energy resources.

The waste types produced by the enterprises as a result of their production are determined as solid, liquid and gas. The enterprises stated that they display an environment friendly approach by

having a treatment facility for disposing the wastes, giving the wastes to recycling companies, storing them in leak proof containers or tanks, and obtaining energy by incinerating them.

According to the Directorate of Provincial Environment and Forest (2008), the enterprises operation in the forestry products industry have an intensive solid waste production as wood, timber, parquet parts and fragments. In addition to this, wood shavings and dust also arise as a result of production. The solid wastes in the shape of particle are incinerated in the furnaces of the enterprises and/or sold for being used in the heating stoves. Wood powder is utilized by being incinerated or by being sold to the particleboard factories.

Considering the applications of the enterprises about environment friendliness; 5 of the enterprises have wastewater treatment facility, 15 enterprises have filtering system, 2 enterprises have recycling facility, 18 enterprises have dedusting system, and 11 enterprises have special environment friendly technology. For environment friendly technologies, the enterprises provided the answers "boiler filter for fuel, dirty water treatment facility, filter in boiler's chimney, ventilation filter, dedusting machines, reuse of impregnated material, dust and carbon gauges in the chimneys, heating system of the administrative building through the water going to the boiler". However, when a research is carried out, there are several environment friendly technologies increasing the quality and quantity of the product, increasing the efficiency, reducing the use of energy, and ensuring recycling etc.

In order to prevent air pollution, the enterprises should use high quality fuel, be inspected continuously, and get emission permission. For preventing the water pollution, the enterprises should establish treatment facilities, regularly operate the existing treatment facilities, and carry out effective audits. In order to prevent noise problem, the enterprises should take measures in line with the regulation, carry out audits, and be established outside the settlement areas in the zoning plans. In the study they carried out for various industries in the city of Düzce, Karadağ and Sevim Korkut (2012) states that the enterprises do not have any application other than using chimney filter for preventing the air pollution and reducing the carbon emission.

For the environment friendliness in the forestry products industry, the enterprises stated that it has less effect on environmental pollution compared to the other industries, and that the high level use of the chemicals force the industry to be more careful about the environment. In addition to this, they state that they do not have knowledge about environment friendly production techniques such as clean production. In their studies, Karadağ and Sevim Korkut (2012) state that a mechanism starting from the enterprises and spreading to the national scale should be created for the clean production method to succeed in the industry.

The enterprises provided the reason why they apply clean production as "reducing the energy costs, reducing the environmental pollution, reducing the raw material costs, increasing competitiveness, and observing the laws". In his studies, Yazgan et al. (2014) determines the most important reason why the enterprises are inclined to clean production is to reduce the environmental pollution, and the second reason is the environmental laws, while reducing the energy costs has the lowest effect.

The clean production applications reduce the water, energy and material consumptions, while it provides saving from waste treatment costs. In addition to this, optimization of the production processes within the production strategy provides an increase in the business efficiency. Within the scope of clean production, costs can be reduced and competitiveness can be increased through applications such as effective material management, accurate selection of resources and services, utilization of suitable technology and optimization of the processes, design approach for increasing effectiveness, reducing the wastes, reuse and recycling. It is also possible to reduce the relevant insurance costs as the environmental risks decrease (TTGV 2011).

Criteria to be used in the clean production process and for creating the databases should be criteria that can be detailed in the basis of "water use, energy use, waste water-solid waste and hazardous waste and air emissions" that would utilize the potential of clean production. The criteria should also be supported with the models where the ecological and economical profit difference between the existing technologies and the clean production techniques and technologies is revealed (Karadağ and Sevim Korkut 2012).

The enterprises have to change their perspective related to the environmental problems, establish dialogs with the environmental organizations and individuals, and restructure their production and marketing policies by taking the environmental impacts of their products (Karacan 2002).

The requirement for providing international solutions due to the global character of the environmental problems increased and continues to increase the value of internationally recognized environmental management systems and relevant standards. Protecting the environment requires efficient use of the natural resources as much as reducing the wastes (Yontar 2007).

Forestry products industry can provide an assistance for solving the environmental problems by using the natural resources more effectively and selecting environment friendly technologies.

## REFERENCES

- Akyüz KC, Yıldırım İ, Balaban Y, Korkut S (2010) Analysis of forest product trade relationships between Turkey and European union member states. *African Journal of Biotechnology* 9(16):2353-2359, ISSN 1684–5315.
- Altınışık Dirik T, Akyol S (2007) Environmentally sensitive approaches in industry: cleaner production and eco-efficiency. MPM Publication No:693, ISBN: 978-975-440-352-7.
- Demirkır C, Çolak S (2006) Reuse of wood based solid waste in panel production industry, *Artvin Coruh University Journal of Forestry Faculty* 7(1):41-50, e-ISSN:2146-698X.
- Directorate of Provincial Environment and Forest (2008) Duzce provincial environmental status report, [http://duzce.ormansu.gov.tr/Duzce/Libraries/%C4%B0l\\_%C3%87evre\\_Durum\\_Raporu/D%C3%BCzce\\_il\\_%C3%87evre\\_Durum\\_Raporu\\_2008.sflb.ashx](http://duzce.ormansu.gov.tr/Duzce/Libraries/%C4%B0l_%C3%87evre_Durum_Raporu/D%C3%BCzce_il_%C3%87evre_Durum_Raporu_2008.sflb.ashx) [02/02/2015]
- Gültekin YS, Kayacan B, Ok K (2009) An investigation on timber demand of forest industry in Düzce Province. *Duzce University, Journal of Forestry* 5(2):75-94, ISSN:1306-2182.
- Karacan AR (2002) Environmental awareness and obligations of businesses, enterprises in terms of environmental protection policies in Turkey and the European Union. *Ege University Faculty of Economics and Administrative Sciences. Ege Academic Review*, 2(1):1-10.
- Karadağ AA, Sevim Korkut D (2012) Examining the sensibilities of the different sectors active in Düzce concerning clean production. *International Journal of the Physical Sciences (IJPS)* 7(1):153- 165, ISSN: 1992-1950.
- Sencar P (2007) Environmental protection and economic growth relationship in Turkey. Master Thesis, Trakya University, The Institute of Social Sciences, Edirne, Turkey.
- Sevim Korkut D, Karadağ AA (2010) Environmental sensitivity in forest products industry; The sample of Duzce. 1st International Symposium on Turkish & Japanese Environment and Forestry, 651-664, Trabzon-Turkey, 4-6 November 2010.
- Tanrıvermiş H, Mülayim ZK (1999). Economic assesment of environmental pollution damages caused by industry on agriculture: the case of Samsun fertilizer (TÜGSAŞ) and Karadeniz Copper (KBİ) industries. *Tr. J. of Agriculture and Forestry* 23:337-345.  
<http://journals.tubitak.gov.tr/agriculture/issues/tar-99-23-3/tar-23-3-10-97016.pdf> [03.02.2015]
- TTGV (2011) Eco-efficiency (clean production) guide in industry: methods and applications, ISBN: 978-975-95878-4-0.  
[http://www.ttg.gov.tr/content/docs/sanayide\\_eko-verimlilik\\_temiz-uretim\\_kilavuzu-yontemler-ve-uygulamalar.pdf](http://www.ttg.gov.tr/content/docs/sanayide_eko-verimlilik_temiz-uretim_kilavuzu-yontemler-ve-uygulamalar.pdf) [10/02/2015]
- Yazgan Hİ, Yıldız, MS, Yücel S (2014) The impact of cleaner production on firm performance: a research on industry firms in Düzce. *The Journal of International Social Research* 7(32):722-733, ISSN: 1307-9581.
- Yontar IG (2007) A tool for sustainable environment and economy: ISO 14001 environmental management system standards in Turkey. *Review of Social, Economic&Business Studies*, 9/10:477-500, Fall 2007-2008.