EVALUATION OF THE ENVIRONMENTAL PERFORMANCE IN THE FURNITURE INDUSTRY – A CASE STUDY

Mayara Ananda Gauer[1]; Waldir Nagel Schirmer[2]; Éverton Hillig[3]; Daniel Bartiko[4]

RESUMO

A indústria moveleira geralmente está associada à geração de grande quantidade de resíduos, uma vez que emprega diferentes tipos de materiais em seu processo de fabricação. Além dos resíduos de origem tipicamente florestal (nos caso de móveis de madeira), fazem parte do processo a geração de sobras de metais, plásticos, vidros, tecidos, etc. e até mesmo resíduos tóxicos (como colas, tintas, vernizes). Apesar da natureza desses resíduos depender da natureza do processo produtivo da empresa, é fato que essa grande variedade de insumos acarretará em grandes dificuldades para o correto gerenciamento destes rejeitos. O presente trabalho teve como objetivo principal diagnosticar a situação ambiental de cinco empresas do setor moveleiro, de portes médio, pequeno e micro, todas localizadas na região centro-sul do Estado do Paraná. Metodologicamente, além de visitas técnicas às empresas, foram aplicados questionários de modo a levantar as principais ações empreendidas pelas empresas do ponto de vista ambiental. Dentre as empresas avaliadas, apesar de todas as empresas afirmarem estar preocupadas com as questões ambientais, verificou-se que pouco tem sido feito neste aspecto. Problemas como mistura de resíduos de diferentes classes (tóxicos e não-tóxicos), má gestão de efluentes líquidos e atmosféricos foram alguns dos principais itens verificados.

Palavras-chave: Gestão ambiental; indústria moveleira; resíduos florestais; setor madeireiro.

ABSTRACT

The furniture industry is usually associated to the generation of a great amount of residues, once it uses different kinds of materials in its manufacturing processes. Besides residues originated from wood (considering wooden furniture), the generation of metal, plastic, glass, and fabric wastes are part of the process and even toxic residues such as (glues, paints and varnishes). Although the nature of such residues depends on the company productive process features, it is a fact that this great variety of materials results in great difficulties for the correct management of such waste. The main aim of this work was to diagnose the environmental situation of five furniture manufacturers, medium, small and micro sized, all located in Center-South region of the Parana State. Methodologically, besides technical visits to the facilities, questionnaires were applied in order to survey the main actions performed by the facilities regarding the environment. Amongst the facilities evaluated, despite all facilities having stated their concern with environmental issues, it was seen that very little action has been taken in this aspect. Problems such as mixture of residues belonging to different classes (toxic and non-toxic), bad management of liquid and atmospheric effluents were some of the main items verified**.**

Key-words: Environmental management; furniture industry; forest residue; wood sector.

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[1] Engenheira Ambiental – Mestranda em Bioenergia. Professora do curso de Engenharia Ambiental da Fundação Municipal Centro Universitário da Cidade de União da Vitória – UNIUV – União da Vitória (PR).
[2] Doutor em Engenharia Ambiental. Professor adjunto do curso de Engenharia Ambiental da Universidade Estadual do Centro-oeste – UNICENTRO – Irati (PR). Autor para correspondência: wanasch@yahoo.com.br. Endereço: Rodovia PR 153, Km 07, Bairro Riozinho, CEP 84500-000.
[3] Doutor em Engenharia Florestal. Professor adjunto do curso de Engenharia Florestal da Universidade Estadual do Centro-oeste – UNICENTRO – Irati (PR).
[4] Engenheiro Ambiental – Mestrando em Engenharia Ambiental pela Universidade Federal do Paraná – UFPR – Curitiba (PR).

1. INTRODUCTION

According to the Furniture Industry Brazilian Association (ABIMÓVEL, 2005), there are in this country about 16,104 manufacturers in the furniture sector which generate about 206,352 jobs. From this total, 2,133 are located in the State of Paraná, employing about 29,079 workers (more than 14% from the total workforce in this sector). Despite significant numbers of the furniture sector in the economy, according to the Technological Research Institute (IPT), very few companies have or develop some environmental management program or manage adequately the residues generated by their productive processes (IPT, 2002).

The furniture industry can generate a diversity of residues, once it employs different kinds of material in its manufacturing process. Besides generating residues typically originated from wood (wood pieces, MDF (*medium density fiberboard*) pieces, plywood, sawdust, shavings, woodchips and powder), metal, plastic, glass and fabric as well as glues, organic solvents, removers, paints and varnishes are part of the process. Although the quali/quantitative nature of such residues depends, obviously, on the features of the manufacturer productive process, it is a fact that this great variety of materials results in great difficulties for the correct management of such waste, once the mixture of different kinds of residues impedes their reusing and recycling and makes it more difficult to dispose them properly (IPT, 2002; KOZAK *et al.,* 2008; NASCIMENTO, 2009).

According to the Technical Norms Brazilian Association (ABNT), in its NBR 10.004 solid residues are defined as:

> All residue in solid and semi-solid state, which result from industrial, domestic, hospital, commercial, agricultural, services and sweeping activities. This definition also includes mud originated in the water treatment system, in pollution control facilities and equipment, as well as certain liquids whose particularities make it impossible to release them in the sewage system or in bodies of water, or that require technical and economical solutions which are not viable when compared to the best technology available (ABNT, 2004).

This same norm also classifies solid residues in class I (hazardous), class IIA (non-hazardous) and class IIB (inert). Such classification is carried out based on the identification of the process or activity which originated the residue, its physical, chemical and biological characteristics as well as through comparisons to lists of residues already identified and classified (KOZAK *et al.,* 2008).

According to Nascimento (2009), the furniture sector industries present great necessity to apply new technologies, which are environmentally friendly and that allow

the reduction in the use of natural resources, minimizing waste and avoiding environment pollution. Taking into consideration the importance that this sector holds in the national economical scenery and considering its environmental aspects and impacts, the high costs involved in recovering polluted environment and the advantages which might be obtained by organizations, the environmental management procedures appear as a viable alternative in order to help the manufacturers to be in accordance with the environmental legislation, reduce production costs and increase their competitiveness. According to Donaire (1995, cited by NICOLLELA, MARQUES & SKORUPA, 2004), environmental management, in the entrepreneurial context, comprises:

> "(…) the implementation of programs aiming at the development of technologies, the revision of productive processes, the study of products life cycle and the production of *green products*, amongst others, which seek to meet legal requirements, take advantage of business opportunities and invest in the institutional image."

Thus, an environmental management system, besides attaching a positive image of commitment with the environment to the company, broadens financial opportunities, by reaching new markets, formed by more demanding consumers (WITTACZIK, 2003; KOZAK *et al.,* 2008).

Considering what has been exposed above and aiming at proposing improvement in relation to the environmental management to the furniture sector in this region, this work has as its main objective to evaluate the environmental performance of furniture manufacturers, of different sizes, located in the Center-South region of Paraná State.

2. METHODOLOGY

This study was carried out in five furniture manufacturers, small and medium sized, all located in the Center-South region of Paraná State. Questionnaires (with closed questions based on those used by Silva, 2001) were applied, which consisted of two parts – one surveying the environmental situation of the companies (diagnoses, approaching environmental aspects associated to the company activities in a current context) and another related to their environmental liabilities.

Besides having the questionnaires answered by the managers of each company, technical visits were paid to the manufacturers for six months, as a complement to the evaluation.

In order to facilitate the exposure of results obtained, the manufacturers were numbered 1 to 5. The general characteristics of each company are summarized in Table 1.

Table 1 – General characteristics of the furniture manufacturers evaluated

COMPANY	NÚMBER OF EMPLOYEES	SIZE[1]	RAW MATERIAL USED	MAIN ACTIVITY
1	25	Small	MDF boards[2]	Manufacturing of bespoke furniture for the domestic market
2	25	Small	MDF boards[2]	Furniture manufacturing for the domestic market
3	140	Medium	Reforestation wood	Wood processing and furniture manufacturing for the external market
4	130	Medium	Reforestation wood	Wood processing and furniture manufacturing for the external market
5	13	Micro	Hardwoods	Manufacturing of bespoke chairs and furniture for the domestic market

(1) Size defined according to the classification of the SEBRAE – Industry (Brazilian Service of Support to the Small and Medium Enterprise) and RAIS (Annual Salary information register), which states (ABIMÓVEL, 2005): micro companies – from 1 to 19employees; small companies - from 20 to 99 employees; medium companies - from 100 to 499 employees; big companies - over 500 employees.

(2) Medium Density Fiberboard

3. RESULTS

Considering the great quantity of residues produced, all companies in this study claimed to be concerned with environmental issues. Three of the facilities have taken concrete action (companies 1 and 5, as presented in Table 1, stated to give final destination to the residues generated, while company 3 claimed having substituted some products for less toxic ones). Despite that, none of them has, up to now, an environment management system implemented.

In the last three years, only one of the facilities was notified in their environmental area, and stated having solved the problems that generated the notification. In this same period of time, only company 4 took actions aiming at reducing or preventing environmental impact.

Four facilities (2, 3, 4 and 5) reported that there is some kind of regular control of the residues generated. However, only two confirmed the existence of some equipment or technique specifically used for pollution reduction (3 and 5). In relation to liquid and atmospheric emissions, it was verified that none of them had an Effluent Treatment Station

(ETS); four of them (1, 2, 3 and 4) had and exhaustion system for particulate matter installed in the equipment that might generate wood powder; and two had an appropriate painting cabin, with its own exhaustion system (2 and 4). Even with the presence of such systems, strong odor was perceived in the finishing rooms and the presence of sawdust and wood powder on the factory machinery and floor. This evidence suggests that the airing systems adopted by the facilities are not sufficiently efficient to capture gases and organic solvents or the particulate matter. None of the facilities keeps a register of the residues generated and, even those who sell such by-products are not aware of the treatment and final destination they receive. Two facilities (3 and 4) claimed to reuse wood waste to feed the company boiler.

Regarding the environmental communication carried out by the companies, three of them inform their employees about the activities with negative impact potential and only one informs the government institutions about the final destination of the residues produced.

Considering differences in size and productive processes of each company, the answers related to environmental aspects and the degree of importance attributed to each of these aspects by the facilities were varied. Table 2 summarizes results observed in this case.

Table 2 – Companies environmental aspects and indication of the degree of importance attributed to each aspect by the managers.

ENVIRONMENTAL ASPECT	**DIMENSION OF RESULTING IMPACTS AND THEIR DEGREE OF IMPORTANCE**				
	Company 1	**Company 2**	**Company 3**	**Company 4**	**Company 5**
Water consumption	NP*	Small	Medium	Small	NP
Energy consumption	Small	Medium	Big	Medium	Small
Toxic products use	Small	Medium	Medium	Small	Small
Solid waste production	Medium	Small	Small	Medium	Small
Liquid effluents emission	Small	Small	NP	NP	NP
Gas effluents emission	NP	Small	NP	Small	Small
Noise	Small	Medium	Small	Small	Medium
Bad smell/odor	NP	Small	NP	NP	Small
Risk of industrial accidents	Small	Medium	NP	Medium	Medium

**Not pertinent to the company activity (according to the company view)*

Results related to the influence the stakeholders have on the person in charge of the environmental policies and actions in the companies, and the main obstacles that impede the enforcement of such environmental actions are shown in Tables 3 and 4, respectively.

Table 3 – Stakeholders degree of influence on the person in charge of the environmental policies and actions within the company

STAKEHOLDERS	**DEGREE OF INFLUENCE**				
	Company 1	**Company 2**	**Company 3**	**Company 4**	**Company 5**
Employees	None	None	None	Weak	Strong
General Direction	Weak	-	Medium	Very strong	Strong
Consumers	None	None	Weak	Very strong	Strong
Competitors	None	None	None	Strong	Medium
Law	Strong	Very strong	Strong	Very strong	Medium
Environmental NGOs	None	None	None	Medium	Medium
Media	Weak	None	Strong	Very strong	Medium
Sciences institutions	None	None	None	Medium	Medium
Local population	Weak	None	Strong	Strong	Medium
Inspection organ	Strong	None	Very strong	Very strong	Medium

Table 4 – Main obstacles to the enforcement of environmental actions within the facility.

OBSTACLES	**DEGREE OF IMPORTANCE**				
	Company 1	**Company 2**	**Company 3**	**Company 4**	**Company 5**
General direction lack of motivation	Very important	Very important	Little importance	Important	Important
Lack of information about the tools available	Very important	Very important	Medium imporance	Important	Important
High cost	Very important	No importance	Medium importance	Very important	Important
Lack of financial resources	Very important	Little importance	Little importance	Important	Important
Lack of viable technical solution	Very important	Very important	Medium importance	Important	Important
Low demand for environmentally friendly products	Very important	Very important	Little importance	Important	Important

Technical information regarding the companies relations with the environmental liability of their activities are shown in figure 1.

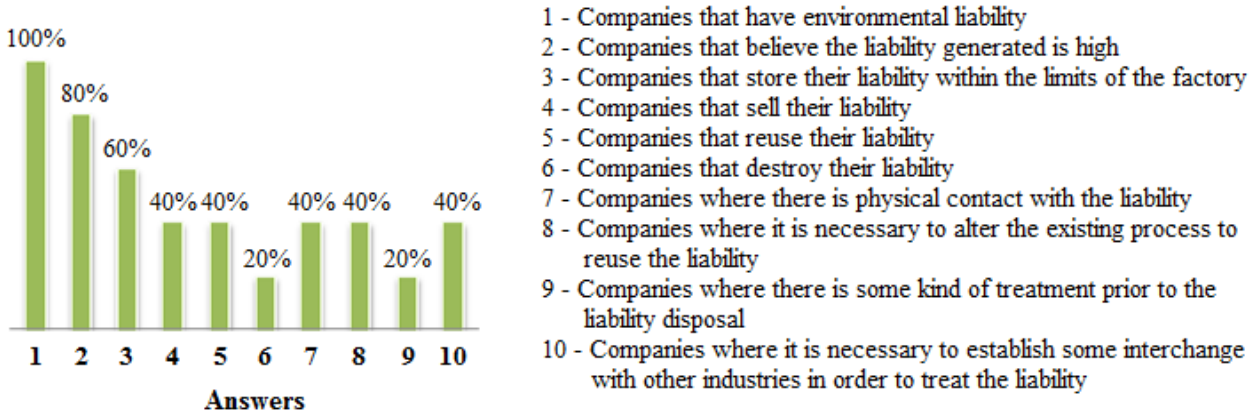

Figure 1 – Relation between companies and environmental liabilities.

4. DISCUSSION

The different answers given by the companies when questioned about their environmental performance are justified by the fact that each one has a particular productive process and different size. According to Schirmer, Cortez and Kozak (2007), regardless the size and productivity, all phases of the productive process of a furniture manufacturer are likely to generate residues (solid, liquid and/or atmospheric). Regarding the companies under study, results show that the potential/dimension of the environmental impact generated by them (use of toxic products, production of solid waste, liquid and atmospheric effluents emission, etc.) in fact did not depend on the size of the company, which can be seen in Table 2.

Even if no relation was established between the size of the company and the kind and amount of residues generated, it was evidenced in general, both by the questionnaires and technical visits, that it is necessary for these companies to adequate their production to some kind of standardized control of the process. Seiffert (2007, cited by Oliveira & Araujo, 2009) claims:

> "the relation between operational control and productive and economic efficiency of the organization, highlighting that with the adoption of more suitable environmental practices and with control over processes and their environmental aspects, using a pollution prevention approach, might be reached, as well as the

> fulfillment of legal requirements and reduction in losses."

Following the same line of thought, PNUMA (1999, cited by Oliveira & Araujo, 2009) highlights that the implementation of an environmental management system might contribute with the reduction in wastes in factories up to 50%. This is contrary to the thought of most businessmen, who relate the implementation of such system to increase in production costs.

The application of an environmental management system based on prevention of residues comprises, for instance, actions such as KIPERSTOK *et al*. (2002):

- Changing equipment/processes: these might include changes in the operational procedure as well as in equipment maintenance;
- Changing raw material: substitution of raw materials and conventional material for others with lower environmental impact;
- Avoiding the mixture of incompatible materials: that is why it is so important to separate residues at the moment they are generated (it will facilitate reuse);
- Taking full advantage of the residues: reuse, return to the process.

Such actions might result in the following proposals of management to the companies under study:

1) *Changing equipment/process:* Some situations which match this item, for instance, are the reduction in paint consumption through pressure adjustment of the painting pistol in the painting cabins or even better use of wood boards during the cutting phase, always aiming at optimizing the use of raw material.
2) *Changing raw materials:* an interesting alternative would be to substitute, in the cases in which it is possible, the use of paints that use solvent for less toxic ones, water based for example, and substitute traditional adhesive for mono-component in aqueous dispersion ones, which do not produce irritating odor, are not inflammable and do not release organic compounds. Yet, if the volume of solvent generated during the painting, personal and machinery cleaning phases is significant, such solvent might be recycled at specialized companies, where the material is 'regenerated' (solid charge is eliminated from the organic liquid phase) by means of distillation. Despite the cost of recycled solvent being much lower than the 'virgin' solvent as it presents lower quality (and application characteristics), it can

still be used to clean machines and operators.

3) *Avoiding the mixture of incompatible materials:* Segregating residues at the source (where they are generated), so that residues of different categories (incompatible) do not get mixed. The commercialization of residues is not always viable because they get contaminated during the process, for this reason it is very important to avoid contact between different categories residues. This can be achieved through the establishment of a residue control policy, which permits to identify and select residues, facilitating recycling and/or final disposal in an environmentally friendly way (ARGENTA, 2007).

4) *Taking better advantage of residues:* Adopting practices of residues generation control at the source, reuse and recycling. The control of generation at the source can be achieved through the use of more durable materials (which minimize waste), through substitution of raw material and technologies or even through changes in the operational practices. Thus, better planning of the production might avoid the generation of a significant volume of residues. If it is not possible to reduce at the source, one can always choose to reuse such materials. Wood waste (woodchips and other pieces of wood), for instance, can be used in the production of particle and fiber boards, hard boards, MDF and also in biomass generation, once they have good heat power. Another way of reusing residues is to rework pieces with defects. Even though these material cannot be reused internally, they can be sent (sold) to companies that use them as raw-material (external recycling) (LIMA & SILVA, 2005; ARGENTA, 2007).

Thus, according to Caus *et al*. (2008), with an environmental policy aiming at prevention, 'a lot of benefit can be achieved such as reduction in environmental costs, lower risk of offenses and fines, increase in productivity, improvement of competitiveness, appearance of innovative technological alternatives, amongst others".

5. CONCLUSIONS

Furniture manufacturer units hardly ever have an environmental management plan (mainly regarding small and medium sized companies). Amongst the companies studied in this work, despite all companies stating their concern with environmental issues, very little is done in this aspect. This ineffective management represents great environmental problem, once the inadequate treatment and disposal can generate significant impact to the environment, varying according to the kind of residues generated in this activity (paint waste, solvent, metal, plastic, paper, etc.). Many of these residues, for example, classified as hazardous (class I, according to NBR 10.004), require special treatment, such as disposal in industrial landfill.

Another common problem in this kind of activity is atmospheric residues, generated mainly while processing wood (cutting), preparing (sanding) and finishing (painting). Particulate materials and organic gases, from solvents, paint thinners, paint, etc., are seen as the great villains at this phase. As well as the solid and liquid residues, atmospheric effluents demand treatment, and the occupational health of these manufacturers workers are directly related to the good quality of the air in such companies. In this case, efficient management alternatives comprise the installation of exhaustion systems (for gases and particulates), which when efficiently adequate to the equipment avoid even the thinnest particles to reach the factory environment, minimizing problems related to their presence in the air and the workers occupational health.

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