

# WASTE MANAGEMENT AND ENVIRONMENTAL MANAGEMENT SYSTEMS: A SURVEY OF AN ITALIAN MANUFACTURING CONTEXT

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**SUMMARY:** Many authors have analysed the environmental aspects and impacts of business activities and the benefits that an environmental management system (EMS) may bring to a company. The aim of this paper is to confirm some of the findings already emerged and to deepen the analysis. The first objective is to investigate practices and customs in waste management by firms, in particular of waste oils, in an Italian manufacturing context. The second objective is to discover associations between the presence of an EMS and the improving of regulatory compliance in waste administration. A questionnaire was addressed to 448 firms producing used oil as a waste and a response rate of 37% was achieved. A statistically significant association between the presence of an EMS and an improved administration of waste was found; in particular, the effectiveness of education and training to help employees make fewer mistakes in waste management emerged.

## 1. INTRODUCTION

As it emerged from the European Business Environmental Barometer (EBEB), a quantitative survey of the state and development of environmental management in Europe, waste and energy consumption generated during production are perceived as the major environmental impacts by European firms from the productive sector (Baumast, 2001).

Once wastes have been produced, the problem of how to manage and dispose of them in the correct way needs to be faced and that is why the European Union issued many green laws which regulate the treatment and the disposing of particular types of wastes, such as waste oils (Council Directive 75/439/EEC), batteries and accumulators (Council Directive 91/157/EEC), end-of-life vehicles (Directive 2000/53/EC), waste electrical and electronic equipment (Directive 2002/96/EC).

Another result that emerged from the EBEB survey was the increasing number of companies which had implemented an Environmental Management System (EMS) or had gained certification to either ISO 14001 or EMAS (Baumast, 2001).

In literature, there has been for a lot of time a debate on the real benefits that an EMS or an

environmental certification brings to a company, under multiple aspects, from environmental performance to profitability or image improvement.

This paper has the objective of analysing, using a survey methodology, some aspects of the themes mentioned above.

The paper, focusing on an Italian manufacturing context, aims first at investigating procedures, practices and customs in waste management and analysing environmental tasks and responsibilities assignment among personnel in the firms involved in the survey, in particular narrowing the survey to companies producing one type of hazardous wastes: used mineral oil.

The second objective of this paper is to discover possible links between the presence of some elements of an environmental management system, such as the identification of an environmental manager, the attendance of training courses, the certification of the system, and more regulatory complying waste administration.

This paper is organized into four major sections: the first section establishes the concept and the importance of waste management, in particular of used mineral oils, and summarizes some of the possible benefits, documented in literature, of EMS's and ISO 14001 certifications; the second section describes the approach and the methodology adopted in the research; the third section is devoted to the illustration of the results and the major findings; finally, the fourth section discusses the theoretical and research implications of the study before identifying directions for future research.

## **2. BACKGROUND**

For European Union member States, according to Council Directive 87/101/EEC, "waste oils" means: "any mineral-based lubrication or industrial oils, mineral or synthetic, which have become unfit for the use for which they were originally intended, and in particular used combustion engine oils and gearbox oils, and also mineral lubricating oils, oils for turbines and hydraulic oils".

Lubricating oils, for the most part, consume during use, while what is left becomes waste oil. In fact, during use, lubricating oil undergoes chemical-physical transformations that make it unfit for its original use and so it must be replaced. If waste oil is disposed of or used in an incorrect way it becomes a hazardous pollutant. This characteristic makes waste oil particularly tricky to manage and this is the first reason why it was chosen to be analysed more in depth. A second reason is because firms of different industries produce it and it therefore allows one to have a general and complete view of the problem; finally because in the north of Italy, where the research took place, there are many manufacturing companies which produce waste oil, and the authors have easier access to this reality. The survey carried out gathers information about the first phase of waste oil management which takes place inside the firm. It focuses in particular on the features of the deposit, the collection and the recovery option.

Another main focus of this research is EMS. An EMS is part of an organization's management system used to develop and implement its environmental policy and manage its environmental impacts. In particular, it is the part of the overall management system that includes organizational structure, planning activities, responsibilities, practices, procedures, processes and resources for developing, implementing, achieving, reviewing and maintaining the environmental policy (ISO 14001, 2004).

Nowadays, due to high market pressure and the ever increasing attention placed on environmental matters, a company can decide to certificate the conformity of its EMS to the requirements of ISO 14001 as a response to external or internal pressures, with the aim of obtaining benefits.

In literature several authors have investigated what sort of benefits may come to companies as

consequences of implementation of formal EMSs (Zutshi, Sohal, 2004; Miles et al, 1999; Petroni, 2001; Hillary, 2004; Poksinska et al, 2003; Peng Tan, 2005): the enhancing of environmental performance; the improvement of the company's image and reputation; financial benefits in terms of efficiency of operations and cost savings; the improving of domestic market share and open access to international markets; the increase of employee motivation, responsibility, awareness. Only some authors (Petroni, 2001; Hillary, 2004; Kwon et al. 2002) mentioned the improving of legal and regulatory compliance as a possible consequence of certification and that was one of the reasons that motivated a deeper analysis of this issue.

Most authors took into consideration in their research only the companies which have a formally certified environmental management system. In this survey the authors decided to enlarge the analysis, considering not only certified companies, but also those in which there are only some of the elements of an environmental management system, such as the presence of an environmental manager in the firm or the attendance of training courses.

The aim is to discover whether, independently from the certification, the presence of these elements may bring some benefits to a company and in particular lead to an improved regulatory compliance in waste administration.

### **3. SURVEY METHODOLOGY**

#### **3.1 The questionnaire**

Data collection for this study was permitted by the use of a survey. The instrument used is a structured questionnaire, sent via fax. Questions were formulated in a clear and precise way in order to avoid possible ambiguity for the reader. The questionnaire was designed to be self-explanatory and to not need an interviewer to administer. All the questions, except the final one, have a closed form with multiple-choice or single-choice answers and do not request the compiler to spend time gathering exact data or information.

The survey consists of four major sections. The first section gathers general information about the company, type of business and respondent position. The second section focuses on waste management in the firm with the aim of investigating tasks and responsibilities assignment among personnel and participation in trade associations and consortia. Section three deals with operative waste oil management, analyzing collection and deposit practices in the company. The fourth and final section gathers information about the possession of quality or environmental formal certifications or EMAS registration and gives the company the possibility to make remarks or comments about the questionnaire.

#### **3.2 Sample and population**

The population investigated consisted of all the manufacturing firms located in the province of Brescia, in the north of Italy, which produce used oil as a waste.

The total population investigated was composed of the 1281 firms that declared to the Chamber of Commerce the production of the waste identified by the code number 13.00.00 of the EWC (European Waste Catalogue), or, in other words, those firms producing used oil or oily emulsions. In the registers of the local Chamber of Commerce, which do not gather the whole information in a complete and accurate way, it was possible to find 448 fax numbers of the firms producing waste oil and so 448 companies composed the sample.

The questionnaire was pre-tested on 27 randomly-selected companies and the response rate was of 29.6% (8/27). After the pilot test, all the other survey forms were transmitted by fax and almost all the companies were telephoned in order to solicit the return of the questionnaire. In

some cases it was necessary to send the questionnaire a second time, after the phone call, since the form had not arrived or had been mislaid. From 448 companies, 166 returned their questionnaire, achieving a response rate of 37.05 %, and all of them were usable and legible.

The issue of representativeness and validity of the sample is highly pertinent. The authors considered reasonable that the sample of firms would be representative of the population if it showed a business composition similar to the one of the population. It was decided to use the Chi-square ( $\chi^2$ ) test, which is one of the most appropriate non-parametric methods for testing statistical significance in such a situation, comparing the whole population of 1281 companies and the questionnaires returned, both divided into 14 classes according to the statistical classification of economic activities in the European Community (Commission Regulation No 29/2002).

A  $\chi^2$  value of 0.78 was obtained. Such value is lower than 5.991 which is the critical value of  $\chi^2$  for 2 degrees of freedom and a significance  $\alpha$  (alpha) of 0.05. Thus, it was not possible to state that the sample is not representative of the population.

## **4. SURVEY RESULTS**

### **4.1 Demographic Information**

A response rate of about 37% was achieved from the survey of used oil producers in the province of Brescia. From the 166 companies who returned their questionnaires, 116 (70%) are small enterprises (less than 50 employees), 38 (23%) medium enterprises (number of employees between 50 and 250), and 12 (7%) large enterprises (250 employees or more). The majority of enterprises were found to be metallurgical (49%) and mechanical (20%), followed by an 8% of plastics manufacturers and a 8% of non-metallic mineral products manufacturers. Thirty eight per cent of the companies were family businesses, while 62% were not.

### **4.2 Findings on waste management**

When asked if they had a formally identified “environmental manager” who is responsible for documents, regulations, environmental licences and permissions, 67% of companies stated that they do. The presence of such a manager is extremely important because this figure represents a reference for all the environmental management system of a firm.

In European Union countries waste administration involves the managing of different documents. For instance, each waste transportation has to be accompanied by a “waste identification form” which reports information such as: name and address of the waste producer; origin, type and quantity of the waste; destination plant; date; route; name and address of the receiver (Council Directive 91/689/EEC). In Italy the waste identification form consists of four copies, one for the producer, one for the waste receiver, one for the transporter, and the last one is sent back to the producer from the receiver within three months from the waste receiving date.

Another mandatory document is the “loading/unloading register” on which the producer has to note down, within a week, all the movements of hazardous waste, in particular: loading operation when waste is produced, unloading operation when waste is disposed, i.e. when it is given to the collector (Council Directive 91/689/EEC).

In Italy, companies are requested to give such information every year to the local Chamber of Commerce, producing the “MUD” (Modello Unico di Dichiarazione = single declaration model), which reports all the details on quantities and features of waste produced by the firm during the previous year. The MUD can be produced on paper or on electronic support.

There are also other particular licences necessary to have a temporary deposit or to manage

some other specific activities.

From the survey it emerges that the Waste identification form and the loading/unloading register are, in the majority of the cases (72% and 67%), filled-in by office-workers, while the compilation of the MUD and requesting of licences are in 47% and 32% of the cases outsourced activities, probably because such documents are more difficult and complex to manage so that very often there are not people in the firm with enough competence in that specific task, even if 61% of the companies reported that employees have attended a course of waste management. When a firm produces a new waste it must face the problem of identifying the correct EWC (European Waste Catalogue) code: 37% of respondents do not insert any new waste in the MUD, while 48% produce between one and five new wastes a year and only 10% produce more than five new wastes (5%, no answer).

Ten per cent of the companies do not have any problems in identifying the EWC code associated to the new waste, 60% ask external consultants for help and 30% ask trade associations or the local Chamber of Commerce.

The majority of enterprises (89%) have a “temporary deposit” in the firm which is due to the administrative facilitations connected to such a type of deposit, since it requests no licences. In fact, only 15% of the firms have a deposit under recovery licence, 11% under disposal licence, 8% both recovery and disposal, while 59% have no particular licences and 7% do not know what type of deposit licence they have. 42% of the companies produce the MUD on paper, while 58% on electronic support.

Information about legal compliance is collected in an indirect way. The questions do not provide information about the correctness of the possible answers; a choice of answers is supplied and the compiler chooses the one that better describes his company, eventually implicitly declaring that a limit is violated, even without being aware of that. A specific question asks how much time elapses before recording produced waste quantities on the Loading/unloading register. Sixty-three per cent of the respondents comply with the time limit of a week, while 37% declare to violate it. When asked about the Waste identification form, it resulted that only a few companies (5%) sometimes have problems with its sending back by the waste receiver. This shows that the managing of the Waste identification form is not a critical activity.

The last question of Section 2 deals with the use of specific software for waste administration and it revealed that only 18% of the companies surveyed use a software to manage waste administration.

### **4.3 Findings on waste oil management**

Section 3 of the questionnaire deals with waste oil management and gathers data on collection and deposit practices in the company.

Once oil is produced, in 78% of the cases it is stored in 200 litre drums or in 1000 litre movable tanks and in 15% of the cases in filled-in or out-of-ground tanks.

Usually the deposit is covered by a roof (52%) or is inside a shed (30%) and the deposit’s flooring is made of cement (48%) or there is a containing basin (33%).

Forty seven per cent of the enterprises indicated that their oil is sent to recovery, 29% to disposal, 9% produce different types of waste oils, some recovered some disposed, but 15% of respondents do not know the destination of their oil.

Almost all the companies give their used oil to authorized collectors and only 2% transport it to the disposal centre by their selves.

The most common collecting services which companies use are oil emulsion collection (39%) and non-polluted oil collection (35%), followed by oil filter collection (7%).

#### **4.4 Findings on formal certifications**

Findings on formal certifications show that 46% of the respondents have a quality certification, such as ISO 9001 or ISO TS 16949 and only 11% have an ISO 14001 certification of their environmental management system or have EMAS registration of their site. Quality certifications are so widespread because they are less recent than environmental ones and this contributes to their acceptance and adoption by companies which appreciate their importance. Miles state that “ISO 14000 will likely enjoy widespread adoption similar to that of ISO 9000 as organizations worldwide are encouraged by their stakeholders (including consumers, communities and clients) to become more environmentally sensitive” (Miles, 1999).

No company in the current survey has an OHSAS 18001 certification on safety and six firms (4%) that have not had a certification yet are involved in the certifying process.

### **5. STATISTICAL ASSOCIATION BETWEEN VARIABLES**

Given that the survey questionnaire involves a good deal of nominal or categorical scale data, non-parametric methods for testing statistical association between variables are the most appropriate. For this purpose, it was decided to use contingency tables  $M \times N$  with the  $\chi^2$  test and a significance  $\alpha$  chosen of 0.05.

From the analysis carried out, it emerged that the size of the firm has a big influence on many aspects of waste management. In fact, statistically significant associations were found between the number of employees and many other variables.

As the size of the firm increases, waste administration is better organized, probably since there are many more resources to make use of, not only economic but also human, software and hardware ones. In fact, Table 1 (Part A and B) shows that in large enterprises workers usually make use of specific software for waste administration and the presence of a formally defined environmental manager is more probable. From Part C of Table 2 it emerges that big companies are more likely to have quality or environmental certifications of their sites probably because they have a well-established managerial culture and because they have money to support the certifying process. On the contrary, family businesses, which usually consist of small and medium enterprises, tend to be more closed to certifications (Part D).

Big firms usually produce more than one new waste every year, probably since the productive processes are more dynamic and flexible (Part E).

Taking into consideration waste management practices, without regard to the dimensions of the firm, it was found that if the company has an environmental certification or registration, it is more likely that employees have attended a course on waste management (Part F).

Furthermore, Part G of Table 1 shows that if company's employees have attended a course on waste management, the loading/unloading register is managed in a correct way. The same also happens if there is an environmental manager in a firm (Part H) or if the firm is ISO 14001 certified or EMAS registered (Part I).

It was also found that a company whose employees have attended a course tends to use software for waste administration (Part J) and that the use of specific software for waste administration leads to a more accurate, methodical and systematic management because it guides the office-worker through ordered procedures, without giving him the possibility to neglect or omit phases or recording.

Table 1 -  $\chi^2$  test results on cross-tabulations among the questions of the questionnaire

	Questions cross-tabulated	$\chi^2$ value	Degree of freedom	Significance $\alpha$
A	<u>Use of software for waste administration</u> Number of employees	7.88921	2	0.01936
B	<u>Formally defined environmental manager</u> Number of employees	10.12157	2	0.00634
C	<u>Company certification (actual or future)</u> Number of employees	13.11193	2	0.00142
D	<u>Company certification (actual or future)</u> Family business	10.90086	1	0.00096
E	<u>New EWC codes assigned a year</u> Number of employees	13.01119	2	0.00149
F	<u>Company certification (actual or future)</u> Attended a course of waste management	5.30156	1	0.02131
G	<u>Attended a course of waste management</u> Correct use of the loading/unloading register	9.66546	1	0.00188
H	<u>Formally defined environmental manager</u> Correct use of the loading/unloading register	10.30004	1	0.00133
I	<u>Company certification (actual or future)</u> Correct use of the loading/unloading register	5.52458	1	0.01875
J	<u>Attended a course of waste management</u> Use of software for waste administration	6.78495	1	0.00919

## 6. CONCLUSIONS

This research made it possible to analyse the waste management practice, in particular of used oil, in an industrial Italian context and to find out its critical features. It emerged that common and simpler environmental tasks are usually done by office workers, while firms ask outside help, usually to external consultants, for more complex problems or for particular permissions. Almost all companies make use of authorized oil collectors and only a few transport used oil to the disposal centre by their selves.

The analysis showed also that employees more trained, usually by specific course attendance, make less formal mistakes in waste administration and that underlies the need and the importance of education and training for a more correct waste management.

Furthermore, it emerges that the dimension of the company has a consistent influence on the way it manages its wastes. In fact big companies have a higher level of organisation and invest more resources in the management of environmental issues.

Finally the research investigated possible links between the environmental management system and the improving and more correct administration of waste. Significant statistical associations between the presence of the elements of an EMS in the firm and an improved administration of waste under multiple aspects were found. For example, in companies which have a formal environmental certification or registration, workers have usually attended a course on waste management and therefore have more competence, knowledge and awareness about documents, regulations and licences. The achievement of ISO 14001 certification or EMAS registration leads to an improvement of legal and regulatory compliance in waste administration, in particular to the loading/unloading register.

Moreover, it would be interesting to conduct further studies with larger sample size and using also alternative statistical tools to test the validity of the results of this paper.

It could also be interesting to analyse different types of waste, hazardous and non-hazardous ones, to discover peculiarities or similarities. Finally, it could be opportune to replicate this study in the future because the data was collected over a period of time when ISO 14001 certification was a relatively new concept to many Italian companies, in particular small and medium ones which form the large majority of the sample.

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