

## TRENDS IN WASTE MANAGEMENT IN RELATION TO INCREASED RECYCLING\*

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**Abstract:** New and environmentally sound goals may be reached in ways that increase the occupational risks in addition to the present health and safety problems among the employees who handle solid waste. Four major trends in Environmental Strategies have been selected for discussion: Increasing complexity of the logistics, increasing privatization, increasing cost, increasing internationalization. As regards environmental problems an international approach is both needed and possible. This situation is very different from the situation as regards health and safety standards, acceptance of occupational risks etc. Among other things, the difference is due to: a) national/cultural differences in accepted occupational exposure, b) microbiological dose/response changes as climatic conditions change, c) differences in the way to organize the work, d) different priorities between environment, health and safety, and economy (social/municipal/private). By way of example the following case is discussed: In Europe new environmental goals have been introduced through the regulation of packaging and packing waste. However, during negotiations of a directive embracing this topic little attention has been paid to the health and safety aspects. In conclusion, the health and safety aspects are not integrated for real in the current dynamic development in the field of waste handling. Among other things, this is due to the lack of data describing the exposures; lack of detailed knowledge of the dose/response of the exposures and consequently the lack of occupational exposure limits. Basically these problems are derived from a lack of international co-ordination and co-operation.

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### INTRODUCTION

To day it is well known that the occupational risk is high among the employees who handle waste. Numerous investigations, including the recent findings of the Danish research program on waste collection and recycling, have documented that the workers are exposed to bioaerosols and experience ergonomic problems at a level well above the average [4, 5, 6].

On top of the present problems it is likely that new and environmentally sound goals may be reached in ways that increase the occupational risks [3]. At present new systems in the field of waste handling may be introduced

in a way that pays little or no attention to the inherent occupational risk.

In order to overcome this problem much research has to be done and a greater knowledge of the development of environmental strategies may be a useful guideline when choosing the priorities of future research topics in the field of occupational risk.

This overview concerns trends in environmental strategies of waste management and the conflicting interests of occupational cost versus environmental benefits. In addition, central sorting versus sorting at the households is considered in relation to the EU directive on packaging waste.

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## TRENDS IN ENVIRONMENTAL STRATEGIES

Solid waste management in industrialized as well as developing countries constantly changes in response to economic conditions, regulatory requirements, and goals and demands set forth by various environmental groups [7]. The changes concern various initiatives related to the purpose of minimizing solid waste. In this paper, four major trends in waste collection and recycling have been selected for discussion: (1) increasing complexity of the logistics, (2) increasing privatization, (3) increasing cost, and (4) increasing internationalization.

**Increasing complexity of the logistics.** Ten years ago the traditional waste collection system was characterized by only one waste stream of mixed waste being collected and disposed of at only one common treatment facility.

In Europe today it is common to separate paper and glass for recycling, separate the organic fraction for biological treatment and have a separate collection of hazardous waste.

New systems that contribute to the complexity of the waste handling systems are being developed and implemented in Europe in order to reduce the environmental load of waste. The new systems may for example include separate collection of combustible and non-combustible waste, used batteries, refrigerators, tires, car-wrecks, electrical and electronic products.

The tendency to solve the environmental problems by establishing independent collection and treatment schemes for different types of waste/products is increasing. As an increasing number of actors are active in the field this may lead to very complex logistics, need for massive campaigns to increase the public awareness, and increasing difficulties in the enforcement of public regulations.

**Increasing privatization.** Traditionally the collection and treatment of waste has been a public responsibility, originally based on hygienic considerations.

Today an increasing number of recycling schemes are introduced by private companies, based on the principles of Product Responsibility. In these cases the waste fraction/product is excluded from the previous public regulation and financing.

At the same time discussions on how to define waste are going on to make a more transparent distinction between waste and products. This includes the ongoing discussions on whether waste treatment facilities, e.g. incinerators and landfills, should be privatized in order to ensure a more cost-effective activity and transparency in the sector, or whether it is an activity of basic public interest that should not play an active role in the economy.

**Increasing cost.** The cost of waste treatment itself is constantly increasing due to the need to improve stack

cleansing, control leachate from landfills, establish landfills by the coast, etc.

Furthermore, economic instruments are introduced in order to regulate the activities. Green taxes have become very popular with politicians as they may even serve fiscal purposes. And the revenues of this type of taxes are substantial.

All in all the total cost met by the private operators in the field of waste handling is increasing at quite a high growth rate. It is not the aim of this paper to discuss to what extent the increasing cost is balanced by social benefits, but to pay attention to the fact that the volume of the private economy of the sector is growing.

**Increasing internationalization.** As a consequence of increasing costs of waste handling and treatment, the relative importance of the cost of transportation diminishes.

For several years the international trade of secondary raw materials, typically waste paper and scrap iron, has been abundant. Environmental priorities leading to increased recycling are pushing new recycling technologies forward, e.g. recycling of different types of plastics and laminates. These technologies involve production capacities of several hundreds of thousands of tonnes per year, calling for raw materials from all of Europe. This leads to a further increase in the international trade.

However, not only the actual trade is changing in a way that may be characterized as an increasing internationalization, but also the legal regulations of waste handling are changing.

The discussions on how to define waste as opposed to products and the understanding of self sufficiency as regards waste treatment have not yet come to an end and call for international regulation. In this context the directives of the European Union [2] are important and the EU Waste Strategy is going to play a major role, but other actors on the international scene, e.g. the World Trade Organization (WTO) are important in questions dealing with competition and free trade.

A review of the EU waste strategy, which was presented by the Commission in August 1996, are considered important in that it stipulates an extensive coordination in the field of waste handling [1]. Priority in the waste strategy is on prevention, i.e. cleaner technology and waste minimization, followed by recovery and finally disposal. Moreover, materials recovery is preferred to energy recovery at incineration plants.

## CONFLICTING INTERESTS: OCCUPATIONAL COSTS VS. ENVIRONMENTAL BENEFITS

As regards environmental problems an international approach is both needed and possible. By way of example, the debate on greenhouse gases and ozone depleting gases reflects a global understanding of the need to find common solutions to common problems.

This situation is very different from the situation as regards health and safety standards, acceptance of occupational risks etc. Among other things, the difference is due to: (1) national/cultural differences in accepted occupational exposure; (2) microbiological dose/response changes as climatic conditions change; (3) differences in the way to organize the work; (4) different priorities between environment issues, health and safety, and economy (social/municipal/private).

**National/cultural differences in accepted occupational exposure.** There is a well established, positive correlation between the standard of living in a society and the standards of health and safety of that society.

Thus, developing countries often rely on simple collection schemes and may lack both appropriate storage equipment as well as special collection vehicles. Furthermore, the waste including hazardous waste and hospital waste is often dumped at large landfills near the cities, where certain groups may earn a living by recycling various materials. The workers engaged in collection and recycling household waste may lack both appropriate training and protective clothing and shoes, which, along with lack of understanding of the hazards associated with waste handling, increases the risk of injuries and infections.

**Microbiological dose-response changes in relation to climate.** In Northern Europe including Scandinavia a discussion has been going on for quite some time as regards the possibility of changing the collection frequency of household waste from weekly to every second week, taking the microbiological activity into consideration. This discussion is irrelevant in the warm climate of southern Europe. Here household waste has to be collected every day to avoid foul air and pests like flies and rats. In the tropic climates having a rainy season the problems may be of a quite different nature. Here it is of importance to have a lid on the bin, simply because heavy rain falling into an open bin may reduce the percentage of solid matter below 25%, which makes it impossible to shovel the waste!

Moreover, the composition of household waste varies as a function of the standard of living. The lower the standard of living, the higher the fraction of organic matters - up to 2/3 by weight in the poorest societies.

**Differences in the way to organize the work.** In certain countries the labor force in this sector is marginal and employed on a short term basis. This means that it is extremely difficult to compare the findings in these countries with the findings in countries that employ the labor force on a stable and long term basis.

Additionally, the structure and layout of new treatment plants is more factory like/industrialized than earlier, e.g. composting plants or plants for centralized sorting of packaging waste. New and maybe unknown hazards have

been introduced for which we lack experience as regards occupational risk.

**Different priorities between environment, occupational risk and economy.** Obviously the economic impact of waste handling is increasing these years. This development is driven by environmental priorities. The inherent occupational risk is not attended to, accepted at its best. So far, no discussions on environmental strategy have included health and safety aspects. This is clearly demonstrated in the analyses of waste streams based on Life Cycle Analyses (LCA), which by tradition do not include the working environment. The approach intends to segregate the most beneficial environmental strategies with focus on raw materials, energy, and special impact categories such as global warming. Up to now, no reference to workers' health has been included in the models, meaning that initiatives are decided upon without any evaluation of the occupational risk.

#### CASE: IMPLEMENTATION OF THE EU-DIRECTIVE ON PACKAGING WASTE

In Europe new environmental aims have been introduced through the regulation of packaging and packing waste [4]. New goals for recycling have been introduced. However, during negotiations of the directive little attention has been paid to the health and safety aspects.

As regards recycling the directive requires the following targets to be met by 1 June 2001:

- Between 50% as a minimum and 65% as a maximum by weight of the packaging waste will be recovered (i.e. incinerated or recovered).
- Between 25% as a minimum and 45% as a maximum by weight of the totality of packaging materials contained in packaging waste will be recycled.
- A minimum of 15% by weight for each packaging material will be recycled (paper/cardboard, metal, plastics and wood).

As far as household waste is concerned two different approaches may be applied to meet these goals: Sorting at source or central sorting.

In a system based on sorting at source focus is on the materials - in this case paper and cardboard and glass. These materials define a broader group than just packagings, but most of the packaging waste is included. The materials are sorted by the household and collected separately. To prepare the collected materials for final marketing requires little or no final sorting.

In a system based on central sorting, e.g. the German DUAL-system<sup>1</sup>, emphasis is on a product - in this case

<sup>1</sup>The DUAL-system is the name of a German recycling concept organized by the company Duales System Deutschland GmbH. It is based on voluntary agreements between the trade and packaging industry.

**Table 1.** Characteristics of sorting at source vs. central sorting like in the DUAL-system (Duales System Deutschland).

	Sorting at source	Central sorting
Waste reduction	approx. 50%	approx. 50%
Annual increase in cost per household	0-300 DKK	2-4000 DKK
Increased occupational risk	0	+++

packagings. The packagings may consist of paper/cardboard, aluminum, tinfoil, plastics and composites. Thus, the system is not aiming at collection of all of the mentioned materials, but only the fraction that constitutes packagings. The mix of packagings is collected and transported to a sorting plant. Substantial sorting of the mixed fraction is needed to achieve a quality that may be marketed.

Sorting of the organic fraction for biological treatment, i.e. composting or biogas production, may be applied by the household in addition to the materials recovery in the two main types of recycling schemes.

Comparison of the two different approaches reveals that the level of waste reduction is equal, but the cost differs. The DUAL-system is approximately ten times more expensive than the simple system based on sorting at source (Tab. 1). Nevertheless, the DUAL-system is very attractive from an environmental point of view. For instance, the time needed for its implementation has been proven to be about only two years. The cost is covered by a minor increase of the product price and is not visible to the consumer in the same way as cost put on top of the annual bill covering public waste handling services. Not surprisingly, the DUAL-system is being introduced all over Europe.

The only parameter that has not been emphasized during decision making is the occupational risk of the DUAL system. Up to now little information has been published, but previous reports indicate that central sorting plants of this kind are very difficult to run in a way that meets modern occupational hygiene standards [3]. However, development of mechanical and electromechanical sorting and separation equipment is likely to reduce the manual labor requirements [7].

## CONCLUSION

At present, the need for global solutions to environmental problems leads to the development of new international solutions within waste handling and the speed of implementation of the new concepts is high.

According to what is said nobody wants to achieve environmental benefits on behalf of the health and safety aspects.

Nevertheless, the health and safety aspects are not integrated for real in the current dynamic development in the field of waste handling. Among other things, this is due to the lack of data describing the exposures and particularly lack of detailed knowledge of the dose-response relationships necessary for establishing universally acceptable occupational exposure limits.

Basically these problems are derived from lack of international co-ordination and co-operation. Much research has to be done if the environmentally sound initiatives, that are controlling the development of the waste handling, are expected to take the health and safety aspects into consideration.

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