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Regional Activity Centre
for Cleaner Production
(RAC/CP)

UNEP

Regional Activity Centre
for Cleaner Production

Ministry of the Environment
Spain

Government of Catalonia
Ministry of the Environment

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FOR CLEANER PRODUCTION
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This is an annual technical publication of the Regional Activity Centre for Cleaner Production (RAC/CP).

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Articles are published in the original language of the author (English or French) and abstracts are also included in Spanish.

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Summary

Presentation

The third issue of *RAC/CP Annual Technical Publication – Mediterranean Enterprises and Sustainability* is out, two years after the publication was conceived and created with the aim of providing the Mediterranean Region with a forum for sharing specific experiences aiming at advancing towards sustainable development, taking place in the enriching diversity of its territories.

Several environmentally significant events both at global level and, more specifically, for the Mediterranean region as a whole, have since taken place, laying ground for future action aimed at preserving our environment. The current trends for meeting this objective are moving towards an integrated approach combining environmental, economical and social concerns. This reading of the situation is supported by a broader use of the concept of *sustainability* and the latest events, such as the World Summit on Sustainable Development (WSSD) and the activities of the Mediterranean Commission on Sustainable Development (MCSD).

Companies are the engine of our economy and a clear example where integrating the three variables above is key. This new issue of the publication includes topics concerning companies as well as other stakeholders with a role to play for extending the approach on sustainability in the Region. This can be observed by the diversity of authors represented here, including Universities, research centres and centres working specifically on promoting sustainable approaches, consultancy firms as well as national and international institutions.

Several articles of the current issue focus on the topic of waste management, considering management not only as end-of-pipe solutions, but also and as first on the scale of priorities, as prevention, reduction and recycling. Notably, issues covered include hazardous waste, as well as the role of composting in providing a way of using organic waste for addressing issues of concern such as desertification and climate change. Moreover, some basic ideas for applying cleaner practices in a specific sector, *i.e.* dairy, are presented.

The obstacles to introducing cleaner production and the business sector's reluctance to adopt it are also an object for analysis, along with strategies and tools that a company may choose for introducing environmental concerns into its entrepreneurial policy. Furthermore, an initiative for transferring environmentally friendly technologies is presented, including the framework for an eventual application in the Mediterranean basin.

Finally, reflections on the role of education in the philosophy of cleaner production are made, based on the results of a round table that took place among University representatives. "*It is not ethical to teach students about the theory of the sustainable use of natural resources, and at the same time, ..., to teach them about methods or technologies that do not include any concept of pollution prevention*".

RAC/CP would like to thank the authors of the current issue for their valuable contributions to the publication and continues to encourage individuals, institutions, organisations and companies to participate in this project that aims at exchanging technical experiences and knowledge contributing to the sustainability of our, unique, Mediterranean Region.

Présentation

Le troisième numéro de *RAC/CP Annual Technical Publication – Mediterranean Enterprises and Sustainability*, la publication technique annuelle du CAR/PP, est sorti. Ceci deux ans après sa conception et création à l'objet d'offrir à la Région méditerranéenne un espace commun pour partager les expériences spécifiques permettant de progresser vers le développement durable et ayant lieu dans la diversité enrichissante de ses territoires.

Depuis lors, divers événements significatifs pour l'environnement se sont produits au niveau global tout comme, spécifiquement, dans l'ensemble de la Région méditerranéenne, en indiquant la voie à suivre dans les actions futures visant la protection de notre environnement. Les orientations actuelles de la poursuite de cet objectif évoluent vers une approche intégrée qui rassemble des aspects environnementaux, économiques et sociaux. Cet fait est particulièrement bien illustré par un usage plus étendu de la notion de *durabilité*, ainsi que par les derniers événements, tels que le Sommet mondial pour le développement durable (SMDD), et les activités de la Commission méditerranéenne du développement durable (CMDD).

Les entreprises sont le moteur de notre économie et un exemple clair où l'intégration des trois variables mentionnées ci-avant est essentielle. Ce nouveau numéro de la publication aborde des sujets qui concernent les entreprises ainsi que d'autres agents qui ont un rôle à jouer pour étendre l'approche de la durabilité dans la Région, comme le révèle la diversité des auteurs qui se sont exprimés à cette occasion : des Universités, des centres de recherches et des centres qui travaillent spécifiquement pour la promotion des approches durables, des sociétés de consultation, ainsi que des institutions nationales et internationales.

Plusieurs articles de ce numéro mettent l'accent sur la question de la gestion des déchets, en concevant cette gestion non seulement comme l'apport de solutions en bout de tuyau mais également, et en premier lieu sur l'échelle des priorités, comme leur prévention, leur réduction et leur recyclage. En particulier, ils s'attaquent à la question des résidus dangereux et au rôle du compostage dans la mise à profit des déchets organiques, pour aborder des sujets de préoccupation tels que la désertification et le changement climatique. En outre, quelques idées fondamentales concernant l'application de pratiques plus propres dans un secteur spécifique, notamment l'industrie laitière, y sont également présentées.

Les obstacles et la réticence à introduire la production plus propre dans les entreprises font également l'objet d'analyse, ainsi que les stratégies et les outils dont les entreprises disposent pour introduire l'environnement dans leur politique d'entreprise. La publication présente en outre une initiative visant au transfert des technologies respectueuses de l'environnement, en incluant le cadre de son application éventuelle dans le bassin méditerranéen.

Enfin, des réflexions y sont faites sur le rôle de l'enseignement dans la philosophie de la production plus propre, sur la base des résultats d'une table ronde qui a réuni divers représentants d'universités. « *Il n'est pas éthique d'enseigner aux étudiants la théorie de l'exploitation durable des ressources naturelles, et en même temps, ..., de leur enseigner des méthodes ou des technologies qui n'abordent aucune notion de prévention de la pollution* ».

Le CAR/PP tient à remercier les auteurs qui ont collaboré à ce numéro en y apportant leurs inestimables contributions, et encourage les particuliers, les institutions, les organisations et les entreprises à participer à ce projet qui a pour but d'échanger les expériences techniques et les connaissances susceptibles de contribuer au développement durable de notre Région méditerranéenne unique.

Presentación

La tercera entrega de *RAC/CP Annual Technical Publication – Mediterranean Enterprises and Sustainability*, la publicación técnica anual del CAR/PL, está ya disponible. Han pasado dos años desde que esta publicación fue concebida y vio la luz con el objetivo de ser un espacio común dentro de la Región mediterránea. Un espacio destinado a compartir las experiencias encaminadas a un desarrollo sostenible que tienen lugar en la valiosa diversidad de sus territorios.

Desde entonces, hemos vivido diversos acontecimientos importantes desde el punto de vista ambiental, tanto a escala mundial como en el conjunto de la Región, que han servido para abrir camino a iniciativas futuras cuyo objetivo sea preservar nuestro medio ambiente. Las tendencias actuales para alcanzar este objetivo se dirigen hacia la integración de los aspectos ambientales, económicos y sociales. El uso más extendido del concepto *sostenibilidad* y los últimos acontecimientos, como, por ejemplo, la Cumbre Mundial sobre el Desarrollo Sostenible (WSSD) y las actividades de la Comisión Mediterránea de Desarrollo Sostenible (CMDS), son una buena muestra de ello.

Las empresas son el motor de nuestra economía y un claro ejemplo de que la clave consiste en integrar las tres variables anteriores. Esta nueva entrega de la publicación incluye temas dirigidos a empresas y a otros agentes que desempeñan un papel importante en la expansión del concepto de sostenibilidad en la Región. La diversidad de autores presentes, procedentes de universidades, centros de investigación y centros que trabajan específicamente en el fomento de nuevos enfoques sostenibles, consultorías e instituciones nacionales e internacionales, pone de manifiesto esta tendencia.

Diversos artículos de la presente entrega se centran en la gestión de los residuos, entendiendo la gestión no sólo como soluciones a final de línea sino también, y ocupando la primera posición en la escala de prioridades, como prevención, reducción y reciclaje. Los residuos peligrosos reciben una atención especial, así como el compostaje, que proporciona una vía de uso de los residuos orgánicos en la lucha contra la desertificación y el cambio climático. Asimismo, se presentan algunas ideas básicas para la aplicación de prácticas más limpias en un sector específico: la industria láctea.

También se someten a análisis los obstáculos y la reticencia que muestran las empresas en la aplicación de la producción más limpia, así como las estrategias y herramientas que una empresa puede elegir para incorporar el medio ambiente en sus políticas. Asimismo, se presenta una iniciativa de transferencia de tecnologías respetuosas con el medio ambiente y el marco de una posible implantación en la cuenca mediterránea.

Finalmente, se plantean algunas reflexiones sobre la función de la educación en el contexto de la filosofía de la producción más limpia a partir de los resultados obtenidos en una mesa redonda celebrada entre representantes de diferentes universidades. "*No es ético enseñar a los alumnos la teoría del uso sostenible de los recursos naturales, y, al mismo tiempo, ..., enseñarles métodos o tecnologías que no incorporan el concepto de prevención de la contaminación*".

El CAR/PL desea agradecer a los autores de la presente entrega sus valiosas aportaciones e invita a particulares, instituciones, organizaciones y empresas a participar en este proyecto que tiene el objetivo de intercambiar experiencias y conocimientos técnicos que contribuyan a la sostenibilidad de nuestra única Región mediterránea.

DIFFICULTIES/ OBSTACLES/BARRIERS TO THE INTRODUCTION OF CLEANER PRODUCTION – AN OVERVIEW

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This short paper takes a look at the various impediments to the successful and widespread introduction of the Cleaner Production process. Reasons for the apparent lack of enthusiasm towards the adoption of Cleaner Production by various authors are also given. The second part of the paper present the results of a survey carried out among the Maltese industrial community to establish the level of environmental awareness. It also highlights the difficulties encountered by industry in the adoption of the Cleaner Production process in spite of the willingness it expressed.

Key words: Cleaner production, end-of-pipe solutions, obstacles, environmental awareness.

Introduction

The list of barriers to the introduction of Cleaner Production is truly formidable, but like any relatively new concept it takes time and perseverance to accept and implement. These barriers/obstacles can stifle even the best-intended efforts of whoever is promoting Cleaner Production. These barriers/obstacles must be recognised and addressed if Cleaner Production is to succeed in minimising the burden industry places on the environment.

One of the many factors limiting the dissemination and widespread use of Cleaner Production is statutory regulation. Gee (1995) maintains that current environmental legislative and regulatory systems focus on end-of-pipe solutions. Rather than encouraging waste minimisation and better use of energy, regulations are mostly aimed at environmental performance targets, but they should also be flexible as to the means by which those requirements are met.

There is also a dire lack of awareness and the required expertise. Decision-makers, more often than not, lack the information they need to develop Cleaner Production. Access to information has to be made more simple and widespread. To build expertise, planners, managers, engineers and other decision-makers need to be trained to integrate the environmental dimension in their strategies and choices in the design of processes and products.

OBSTACLES TO CLEANER PRODUCTION

There is no doubt that any innovative approach to set procedures is bound to encounter difficulties and opposition, Cleaner Production is no exception to this rule, and a review of some of the literature shows clearly that there are hurdles to be overcome.

Noel (1992) claims that there are at least five fundamental reasons which serve as obstacles to the application of Cleaner Production in industry:

1. Habit and routine.
2. Suspicion of new technologies compared to old ones.
3. Lack of effort by Governments to encourage Cleaner Production development.
4. Lack of institutional support through regulations for firms or plants to agree on better valorisation of by-products or wastes through Cleaner Production.
5. In an effort to minimise the use of hazardous raw materials, industrialists might be required to use alternatives which they are not accustomed to, or to extract quantities of impurities that sometimes do not constitute a hazard.

Another important factor which limits the adoption of Cleaner Production practices is human resistance to change.

In any manufacturing facility the most significant barriers would most probably be the workers. Burns (1992) mentions human barriers to waste minimisation programmes as part of a Cleaner Production strategy, as being the result of the combination of fear and lack of planning and information.

The creation of human barriers can be the response to:

1. *Fear of decreasing productivity* – Workers in industries where production bonuses are in place, would not accept any measure which prevents them from reaching production targets, and hence earning the bonus.
2. *Fear of altering product quality* – Any measure, which, in management's perception, might affect the quality of the product (hence resulting in a drop in sales), would definitely not be implemented.
3. *Lack of upper-management support* – The perception by the rank and file, mistaken or otherwise, of lack of support from top management is bound to spell failure to any innovative changes.
4. *Lack of specific goals and objectives* – The absence of any specific goals would result in the workers not having the sense of direction so necessary for motivational purposes.
5. *The resistance of managers to including employees in the waste minimisation process* – Unless the shop floor/ operators are included in any waste minimisation programme, this is bound to fail. These workers handle the bulk of materials from which waste is created and are in the best position to identify waste minimisation possibilities.
6. *Lack of information on waste minimisation techniques and principles* – The absence of adequate information, hence lack of understanding, always results in lack of or diminished motivation.
7. *Lack of feedback systems for tracking purposes* – It is imperative to monitor the outcome of any measures taken, as the results can then be quantifiably illustrated.

Human barriers to waste minimisation programmes are the result of the combination of fear and lack of planning and information

If Cleaner Production is to be successfully implemented, among all levels of industry, attitudinal changes must take place from top management down to the shop floor.

Even small and medium-sized enterprises (SMEs) are faced with many barriers for the successful adoption of Cleaner Production methods and hence pollution prevention. Atkinsons (1994) mentions a few, but nevertheless important factors which might be instrumental in creating barriers:

1. Many SMEs are unaware of pollution prevention opportunities or their relative merits over end-of-pipe solutions.
2. Very few SMEs analyse their waste streams to identify pollution prevention opportunities.

3. Many lack the knowledge of technical alternatives or may not possess the engineering expertise needed to modify or redesign processes.
4. Sometimes SMEs doubt whether pollution opportunities or technologies exist.
5. Often when seeking expertise from consultants, they are steered away from prevention in favour of generic end-of-pipe equipment.

Other impediments to the use of Cleaner Production alternatives to existing systems by industry may include:

1. Lack of knowledge at the plant level of Cleaner Production and the economic and pollution reduction benefits that it can offer industry.
2. Difficulty in getting information on Cleaner Production changes and methods which are industry-specific.
3. Absence of information on case studies of Cleaner Production methods. Known, credible examples are needed to convince local industries that it can actually be done i.e. financial as well as pollution-reduction benefits.
4. Rejection of an innovative approach by some managers, merely because it is outside their range of experience.
5. Lack of technical staff or adequately qualified staff to enable the changes or modifications necessary for the introduction of Cleaner Production to be implemented. This is especially true of small and medium-sized enterprises using long-established technologies.
6. The belief that changes needed to adopt a Cleaner Production programme require significant capital investment. Companies usually indicate that their financial condition does not allow them to make such an investment. This is not always true, as, sometimes, even simple good housekeeping practices, (e.g. repairing lagging/leaks in pipes, etc.) can result in considerable savings.
7. The perception that pollution prevention expenditure does not bring financial benefits to a company's operations. In fact, according to a study carried out by Huising et al., (1986), the majority of cited cases of investment for the implementation of Cleaner Production methods claim pay-back periods of less than 3 years.
8. The feeling in industry that if it is not required by law or other enforcement mechanisms, it need not be done. Even if the laws exist but the enforcement mechanism is not well developed, industry does not feel the urgency to comply.
9. Lack of capability at national level to support industry with the carrying out of proper environmental audits and evaluating, seeking and developing of Cleaner Production alternatives.
10. Trade unions have expressed growing fears that stringent environmental regulations and policies will inevitably lead to industrial restructuring, and with it job losses. However Long (1994) cites studies by the OECD and others that have indicated that such worries are overstated at least at the macro levels. At the micro level (i.e. at the individual plant level), some jobs may indeed be lost, especially if proper training to upgrade workers' skills is not planned for and provided. The number of jobs lost is usually very small and these workers can usually be assimilated in other activities within the same company.

It is possible to summarise the numerous barriers and group them in a general way:

Governmental Barriers – Lack of clear environmental performance targets/ absence of fiscal incentives/lack of institutional support.

Organisational Barriers – Non-involvement of employees in waste minimisation programmes/too much emphasis on production.

Technical Barriers – Non-availability of trained personnel/technology limitations/limited access to technical information.

Economics Barriers – Exclusion of environmental costs from economic analysis/fear of high cost of Cleaner Production implementation.

Attitudinal Barriers – Job security/fear of failure/lack of good housekeeping culture/resistance to change.

Systemic Barriers – Poor record keeping of material, water and energy consumption/ineffective management systems/inadequate production planning.

Once the barriers have been identified, finding ways and means to overcome them becomes less difficult. Naturally, all stakeholders (Industry, Government, Unions and Consumers) must be ready to support initiatives to facilitate the implementation of Cleaner Production.

SURVEY

The Cleaner Technology Centre (CTC) of Malta conducted a survey to evaluate the level of environmental awareness among the industrial sector during 2001. It also tried to gauge the perception of barriers to the introduction of Cleaner Production Processes.

This survey took the form of a questionnaire sent to 300 Maltese industrial concerns.

Responses to this self-administered postal questionnaire were received from 197 enterprises, this represents a response rate of 65.7%.

The profile of these enterprises is presented in Figures 1 – 4.
The number of respondents from the different industrial sectors is presented in figure 1. Whether they are local market or export oriented is illustrated in figure 2.
The number of employees clearly shows that the majority of respondents were small and medium-sized enterprises (figure 3).
In the last figure (figure 4) the age profile illustrates that the work force is relatively young.

The responses to the various questions from the various industrial sectors are graphically represented in the following page as Q1 – Q 7.

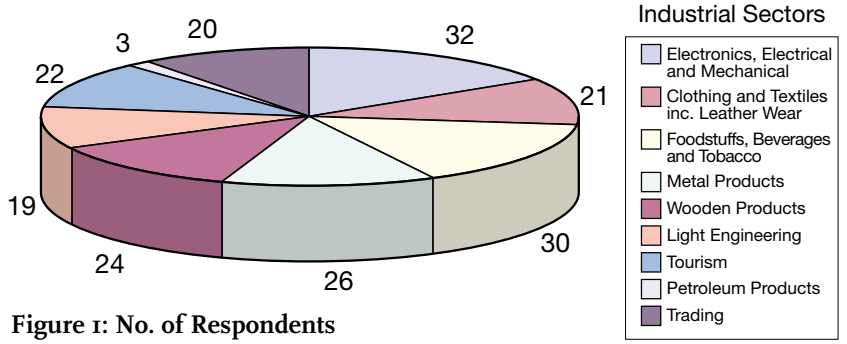


Figure 1: No. of Respondents

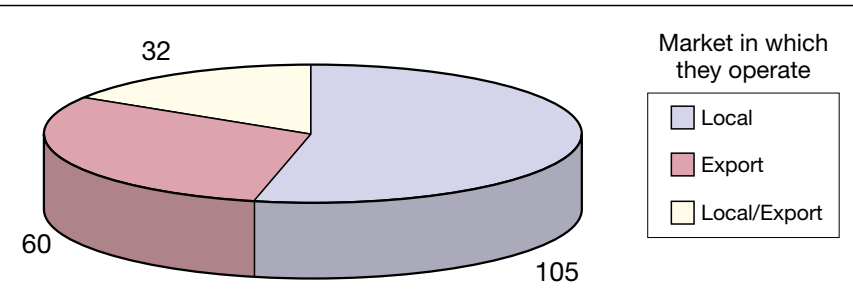


Figure 2: No. of Respondents - Market Profile

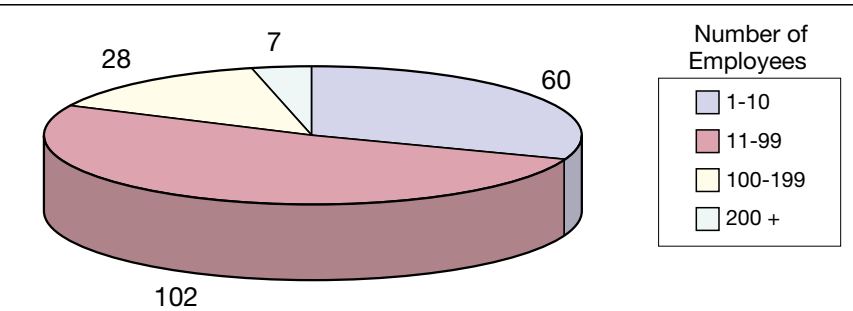


Figure 3: Respondent Companies - No. of Employees Profile

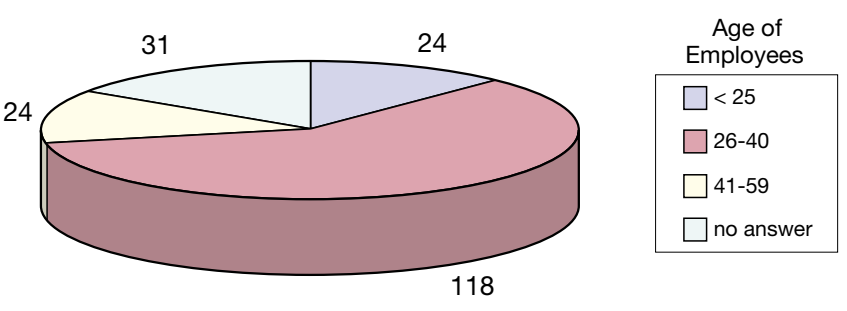
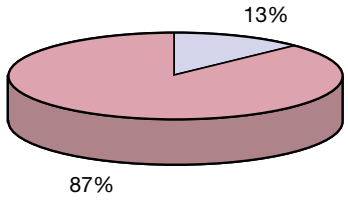
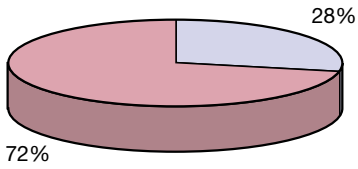


Figure 4: Respondents - Employee Age Profile

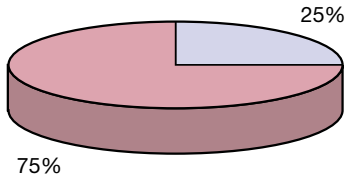
ANALYSIS OF SURVEY RESULTS



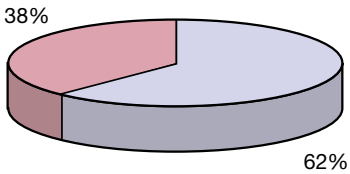
Q 1: Do you have a company environmental policy?



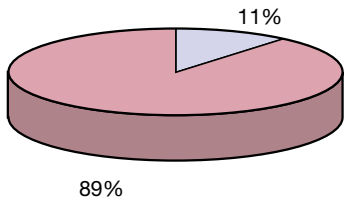
Q 4: Is any fraction of the waste produced by your process recycled?



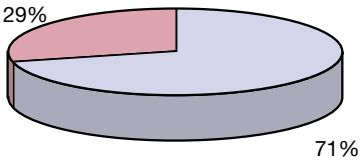
Q 2: Does your company have an appointed environmental manager or coordinator?



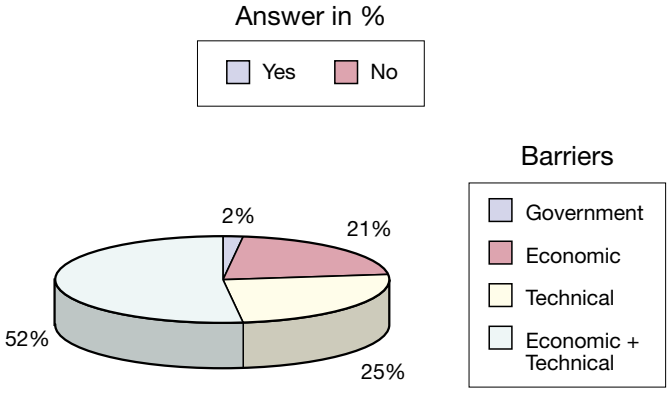
Q 5: Do you have any plans to implement cleaner production processes?



Q 3: Do you have a cleaner production system in operation?



Q 6: Are you experiencing any difficulties in implementing CP processes?



Q 7: Which difficulties/barriers prevent you from implementing CP?

The majority of the respondent companies admitted not having a company environmental policy.

Three-quarters of those answering the questionnaire also replied in the negative when asked whether they have a designated person looking after environmental matters. The absolute majority (89%) also admitted that they have no system in operation which involves Cleaner Production.

However 62% of respondents answered in the affirmative when asked if they have plans to adopt cleaner production processes.

A majority also admitted to experiencing difficulties in implementing Cleaner Production (71%).

When asked which were the barriers/obstacles preventing them from adopting Cleaner Production procedures (see Q7) the most frequently given reason was a combination of economic and technical difficulties (52%).

Conclusions

In conclusion it must be stated that evidently we (proponents of Cleaner Production) have more work to do in surmounting the barriers to acceptance. It is the feeling of the author that to enhance the chances of the concept of Cleaner Production becoming more widespread, the emphasis on the financial benefits must be strengthened. This is especially true with regard to small and medium-sized enterprises (SMEs). Also, the terminology must be couched in a language which is understood by the industrial fraternity otherwise communication tends to break down, and interest in the Cleaner Production process wanes.

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DIFFICULTÉS/OBSTACLES À L'INTRODUCTION DE LA PRODUCTION PLUS PROPRE : VUE D'ENSEMBLE

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Ce bref rapport examine les divers facteurs qui font obstacle à l'introduction efficace et généralisée du processus de production plus propre. Diverses raisons sont présentées par de différents auteurs pour le manque apparent d'enthousiasme envers l'adoption de la production plus propre.

La seconde partie du rapport présente les résultats d'une étude menée auprès de la communauté industrielle maltaise visant à établir son niveau de conscience environnementale. Cette section met également l'accent sur les difficultés rencontrées par l'industrie relatives à l'adoption du processus de production plus propre, et ce malgré la bonne volonté exprimée par cette communauté.

Mots-clé : Production plus propre, solutions en bout de tuyau, obstacles, conscience environnementale.

DIFICULTADES, OBSTÁCULOS Y BARRERAS A LA INTRODUCCIÓN DE UNA PRODUCCIÓN MÁS LIMPIA: UNA VISIÓN GENERAL

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Este breve documento analiza los diversos impedimentos que obstaculizan una implantación extensa y eficaz de procesos de producción más limpia. Varios autores apuntan distintos motivos que explican la aparente falta de entusiasmo en la adopción de la producción más limpia.

En la segunda parte del documento se presentan los resultados de una encuesta realizada en la comunidad industrial de Malta con objeto de determinar el nivel de sensibilización ambiental. Los resultados de la encuesta destacan las dificultades a las que se enfrenta la industria, incluso a pesar de manifestar su voluntad de hacerlo, a la hora de adoptar procesos de producción más limpia.

Palabras clave: Producción más limpia, soluciones a final de línea, obstáculos, sensibilización ambiental.

THE ROLE OF BIODEGRADABLE WASTE MANAGEMENT IN THE FIGHT AGAINST DESERTIFICATION AND THE GREENHOUSE EFFECT IN ITALY

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Waste generation poses a serious environmental problem requiring specific management. This management must be sustainable and based on prevention and minimisation practices.
The recycling of biodegradable waste as compost is a priority established by law in Italy, along with a series of recycling targets to be met. This article contains statistics on the meeting of these targets by region and the number of composting facilities.
Composting plays an important part in integrated waste management and in improving soil properties. It can restore fertility and counteracts the depletion of organic matter, helping to combat the effects of desertification and reducing CO_2 emissions – a major aim of the Kyoto Protocol.

Key words: Biodegradable waste management, composting, desertification, Kyoto Protocol, emissions.

Introduction

Waste generation is becoming a very important problem due to improved economic conditions, the rapid growth of industry and the growth of population and urban areas.

Differentiation of productive processes has caused diversification of waste types with serious environmental consequences.

The growing amount of waste is the cause of reduction of resources, and its quality, in terms of hazardous content, the cause of environmental problems during the management phase.

More attention should be paid to waste prevention and minimisation practises according to the Community Waste Strategy, which sets out a hierarchy of actions giving preference to waste-management options of minimisation, followed by reuse, material recycling and energy recovery and finally safe disposal.

The challenge of decreasing waste quantities cannot be met only by means of efficient waste management and recycling. There is an urgent need for a sustainable waste management where waste prevention, reduction of resources depletion, energy consumption and minimisation of emissions at source should be given high priority. Waste must be handled as a part of the global material flow.

Integrated waste management strategy should be based on the principle that preventive actions should be taken:

- reduction of production and use of hazardous substances
- recovery, re-use and recycling must be preferred to energy recovery also by improving waste collection and source separation
- landfilling should be allowed only for non-recyclable treated materials

Various health and environmental problems linked to the current management of waste could be reduced by diverting waste away from landfills and incinerators, thus preventing and minimising the environmental impacts of waste treatment and disposal.

COMPOSTING IN INTEGRATED WASTE MANAGEMENT

Composting of separately collected biodegradable waste seems to be advantageous in countries where soils have become very poor in organic matter.

Recycling biodegradable waste is a priority established by the Italian law 22/97 in terms of separate collection targets: 15% in weight of total municipal waste in 1999, 25% in 2001 and 35% in 2003.

Although source separation of organic waste is not compulsory, it is necessary in order to reach the medium-term recycling targets of 35%.

Separation at source is becoming the important part of the waste management system, yielding high recycling rates on account of the high-quality separately collected fractions. Composting of biodegradable waste with a low content in impurities is more likely to meet compost standards according to Italian law 748/84 on fertilisers and be suitable for sale and use with environmental benefits.

Today agricultures are oriented to high quality compost deriving from separately collected biodegradable waste while there is no interest in agriculture for compost from mixed solid waste.

Compost derived from mixed municipal waste has to be land applied keeping a control on soil quality before and after use. This kind of compost could be used in land reclamation projects.

Legislation can play an important role in emphasising the recovery of the organic fraction of municipal waste

Legislation can play an important role in emphasising the recovery of the organic fraction of municipal waste. Existing legislation on quality compost should be integrated with rules on low quality compost that guarantee both real new markets for this kind of materials and high level protection for the environment.

It has been estimated by APAT that the amount of compost deriving from the maximum collection rate of biowaste (about 100 kg per capita, equal to 2.4 million tons of compost) would fulfil only 1.2% of the needs for organic matter in national agriculture.

A study by Veneto Region, published in 1997, evaluates the Italian needs of compost at 15 million tons/year.

SEPARATE COLLECTION OF BIODEGRADABLE WASTE IN ITALY

In Italy municipal waste generation amounted to 28.96 million tons in 2000, corresponding to a per capita generation of 501 kilos. Of the total waste generated, 14.4% or about 4.18 million tons, have been separately collected. ("Rapporto Rifiuti 2002" ANPA and ONR).

Northern Italy is more efficient in separate collection practices in comparison to Central and Southern regions: Lombardy, with 32% separate collection, has exceeded the 2001 target set by Law 22/97 (25%) and is near to the 2003 target (35%), Veneto too has exceeded the 2001 target (25%) with 26.6% and is quite near to the 2003 target (35%), Trentino-Alto Adige with 23.3% Emilia Romagna with 21.7%, Toscana with 21.4%, are near to the 2001 target (25%). Separate collection is lower than 2% in some Southern regions such as Campania (1.8%), Calabria (1.1%), Sicilia (1.9%) and Sardinia (1.7%). The exceptions are Basilicata (3.4%), Puglia (3.7%), Abruzzo (6.1%) and Molise (2.3%).

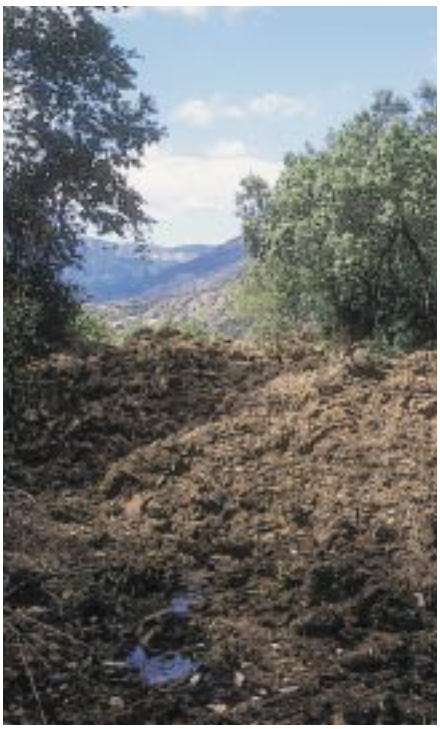
In order to reach a high collection target, source separation of biodegradable waste is needed; in 2000 separately collected biodegradable waste increased by 16% with respect to 1999.

COMPOSTING IN ITALY – THE STATE OF THE ART

In Italy, the number of composting and RDF facilities for mixed waste increased from 47 in 1999 to 56 in 2000 while treated waste quantities increased from 2.3 million tons to 3.1 million tons (+31%). ("Rapporto Rifiuti 2002" ANPA-ONR).

As regards selected biodegradable waste, treated quantities rose from 1.36 million tons in 1999 to 1.89 million tons in 2000. The number of facilities was 208 in 2000 (including a green platform) against 137 in 1999.

The total composting capacity in 2000 was 2,966,237 tons.



DESERTIFICATION AND REDUCTION OF GREENHOUSE GAS EMISSIONS: THE ROLE OF COMPOSTING

The role of composting in integrated waste management is to reduce the amount of municipal waste requiring disposal (by almost a quarter) and to provide a nutrient-rich soil amendment. Indeed the use of compost on land improves soil structure, texture, aeration, and water retention and contributes to erosion control, soil fertility, proper pH balance, and healthy root development in plants.

Desertification is a real problem due to climate changes, human pressure, and physical, chemical and biological degradation affecting the soils.

Intensive humus-consuming crops, the use of mineral fertiliser rich in phosphorous, nitrogen and potassium make soils lacking in organic matter and favour the erosion process.

Desertification could be caused by deforestation and by salinisation linked to incorrect irrigation in dry regions.

In recent years, Italy, according to the UN Convention to Combat Desertification, issued specific guidelines to solve this problem.

In Italy there are many areas that have been deforested (Sicilia, Sardinia, Calabria, Basilicata) and others that have adopted intensive crop farming (Pianura Padana), resulting in a high rate of desertification.

It is estimated that 27% of the Italian territory is vulnerable to desertification and 69% is estimated to be at moderate risk.

The degradation of soils is due to the loss of organic matter. Organic matter means fertility, permeability and stable soil structure.

In order to counteract the depletion of organic matter the use of compost to restore fertility and improve the growth of crops should be promoted by means of financial and economic tools.

The Kyoto Protocol, ratified by Italy, aims to significantly reduce greenhouse gas emissions.

The main agents of global warming, making a distinction between natural and anthropogenic greenhouse effects, are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and halogenated chlorofluorocarbons (CFCs), SF_6, hydrofluorocarbons (HFCs).

Landfilling organic waste produces methane. Indeed landfill materials degrade very slowly due to the lack of oxygen. As they decompose, they produce methane gas and acid leachate, which are both environmental problems. In 1997, in Italy, 44% of methane emissions derived from waste treatment and disposal (mainly due to landfill and sludge treatment); in 1990, in the EU, waste disposal was responsible for 32% of total methane emissions. On this account the Landfill Directive 99/31/EC establishes that all wastes be properly treated prior to landfill.

The use of compost to restore fertility and improve the growth of crops should be promoted by means of financial and economic tools

The Kyoto Protocol calls for measures for CO_2 reduction in agriculture. Climate conditions combined with incorrect agricultural practices deplete organic matter and accelerate the mineralisation of soils.

In this sense the use of compost on soil could compensate the loss of organic matter resulting from mineralisation.

Compost is organic matter with a slow carbon release; it has been estimated that a 0.15% increase in organic carbon in Italian soils would be sufficient to fix a CO_2 quantity equal to the total national emissions due to fossil fuel combustion over one year.

Compost is an efficient tool to reduce CO_2 emissions and to fix carbon in the soil in form of humic substances, thus restoring fertility and allowing the assimilation of CO_2 through the increase of green or vegetable production.

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LE RÔLE DE LA GESTION DES DÉCHETS BIODÉGRADABLES DANS LA LUTTE CONTRE LA DÉSERTIFICATION ET L'EFFET DE SERRE EN ITALIE

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La génération de déchets pose un problème environnemental significatif demandant une gestion spécifique. Cette dernière doit être durable et fondée sur des pratiques de prévention et de minimisation.

En Italie, le recyclage des déchets biodégradables en compost et l'atteinte d'une série de cibles de recyclage sont des priorités établies par la loi. Cet article présente des statistiques sur l'atteinte de ces cibles région par région ainsi que sur le nombre d'installations de compostage.

Le compostage joue un rôle important dans la gestion intégrée des déchets et dans l'amélioration des propriétés des sols : il permet en effet de restaurer la fertilité et remédie à l'épuisement des matières organiques, en facilitant la lutte contre les effets de la désertification et en réduisant les émissions de CO_2, objectif principal du Protocole de Kyoto.

Mots-clé : Gestion des déchets biodégradables, compostage, désertification, Protocole de Kyoto, émissions.

EL PAPEL DE LA GESTIÓN DE LOS RESIDUOS BIODEGRADABLES EN LA LUCHA CONTRA LA DESERTIFICACIÓN Y EL EFECTO INVERNADERO EN ITALIA

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La generación de residuos constituye un problema ambiental significativo y por ello requiere una gestión específica, que, además de ser sostenible, debe basarse en prácticas de prevención y minimización.

En Italia, como parte de un conjunto de objetivos de reciclaje a cumplir, la transformación de los residuos biodegradables en compost constituye una prioridad establecida por la ley. El presente artículo contiene una estadística sobre el cumplimiento de tales objetivos por región y por número de instalaciones de compostaje.

El compostaje desempeña un papel importante en la gestión integrada de los residuos y en la mejora de las propiedades del suelo. Además de permitir restaurar la fertilidad de los suelos, contrarresta el agotamiento de la materia orgánica, contribuyendo con ello a combatir los efectos de la desertificación y a reducir las emisiones de CO_2, objetivo principal del Protocolo de Kioto.

Palabras clave: Gestión de residuos biodegradables, compostaje, desertificación, Protocolo de Kioto, emisiones.

CLEANER PRODUCTION IN UNIVERSITY CURRICULA

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A round table entitled “Cleaner Production in University Curricula” was held within the framework of the LIFE project "Capacity Building in Cleaner Production in Bosnia and Herzegovina". The goal of the round table was to gather together representatives of the Universities and raise discussion on the importance of Cleaner Production and human resource development for the economic recovery of the country.
Future industrial development based on Cleaner Production will bring industrial activity closer to meeting sustainable development targets because it would both reduce pollutant discharge, and increase the efficiency of raw material and energy utilisation. As Cleaner Production requires a **change of attitude** and **multidisciplinary skills**, education and capacity-building on Cleaner Production will be essential for its implementation.
This paper reflects the problems encountered, and the discussion that arose during the round table in the context of the role of the universities in promoting Cleaner Production (CP).

Key words: Cleaner Production, economic recovery, waste costs, human resource development, university education.

CP AND ECONOMIC RECOVERY

For Bosnia and Herzegovina, as a country in transition, the embracement of the Cleaner Production concept is an imperative. Bosnia and Herzegovina must follow the road towards sustainable development, an official request made at the Johannesburg Summit. Bosnia and Herzegovina is a country in transition, whose government has the very difficult task of mapping the way to its economic recovery and coming out of poverty. The government should design measures that will help stimulate economic development, improve standards of living and at the same time preserve the country's natural resources.

The causes of poverty and environmental degradation in B&H and other countries in transition are usually of a similar nature, i.e. based on the inefficient consumption of natural resources.

The EU Environment Commissioner, Margot Wallström, recently called attention to this dynamic, she stated, "If you want to develop your economies and access the European markets, you cannot afford to have these basic elements of health. European consumers will not buy your goods or visit as tourists unless they have confidence that your environment will not damage their health. More than nine out of ten people in a recent Eurobarometer survey felt that candidate countries must protect the environment if they are to be allowed join the EU. This took second place in the list of issues considered to be important to the public. To move closer to the Union you need to overcome this concern".

For industries to produce competitive products and to comply with environmental standards, their activities and investments should be orientated towards the improvement of internal production processes and provide alternative pollution prevention measures.

Cleaner Production can significantly contribute to the preservation of natural resources, and at the same time increase the profitability of industrial companies

These measures include: a) reduction of the pollution at source, b) recovery and recycling, and c) application of good housekeeping practices. The introduction of Cleaner Production can significantly contribute to the preservation of natural resources, and at the same time increase the profitability of industrial companies.

An analysis of production costs of one company showed that a significant percentage of its costs were connected to the generation of waste during the production process and other related activities. With a detailed analysis of waste costs, it was proved that up to 80% stemmed from the uncontrolled consumption of raw materials and resources, especially water and energy. Raw materials in waste flows place significant burdens on the environment and at the same time require adequate disposal or treatment to comply with emission standards. Waste flows represent a financial loss for the enterprise and contribute to the increase of the final price of the product because any raw materials consumed in an inefficient manner result in waste and losses. Disposal of such waste is costly undertaking, and further financial resources are subsequently required for environmental protection fees.

Cleaner Production reduces consumption of raw materials and resources, and also reduces waste generation at source. In most cases, it is possible to reduce pollution with only a small financial investment and minimise, or even completely eliminate, the need for investments in wastewater treatment plants. Therefore, Cleaner Production is recognised as a key concept that results in environmentally sustainable and economically viable business practices, and its promotion and implementation can help the economic revival in Bosnia and Herzegovina.

CP REQUIRES MULTIDISCIPLINARY SKILLS

The concept of Cleaner Production not only focuses on industrial production, but it can also be related and applied to all activities which might have a negative impact on natural resources. **It is a conceptual, procedural approach, which requires that all phases of the life cycle of certain activities should be performed with the objectives of preventing or minimising the short and long-term risks to human health and the environment**.

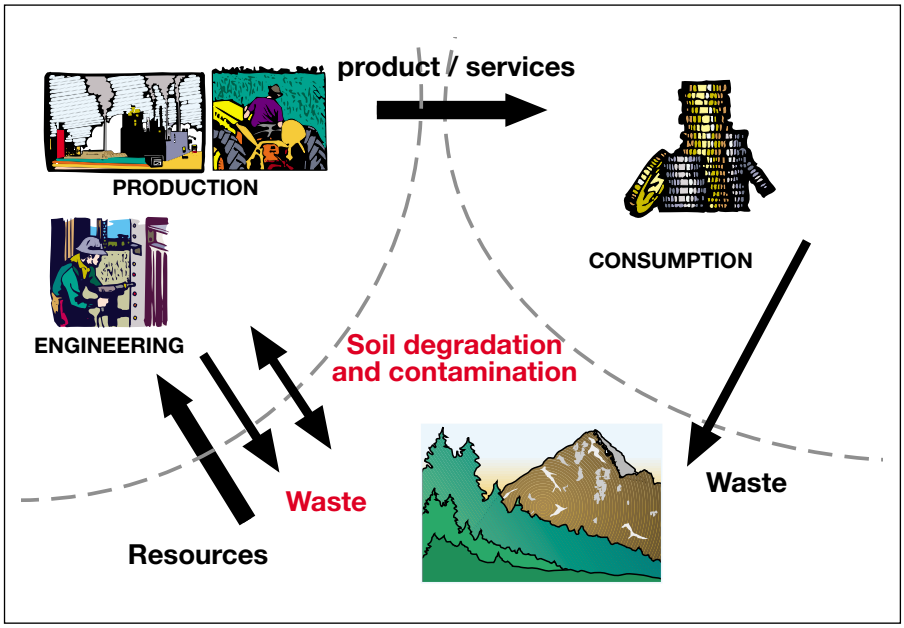
Cleaner Production represents a continuous application of **a global, preventative, environmental** strategy to **activities, processes and products** with the aim of minimising raw material consumption and any negative impact on the environment. Cleaner Production demands that all aspects which might impact on the environment are **integrated** in planning process as well as in the activities **developing** process. This is the reason why the activities where this concept may be applied are very far-reaching, involving as they do:

- Industrial production
- Agricultural production
- Mining
- Forestry
- Engineering
- Services
- Trade

For this concept to become a part of everyday practice would require a **change of attitude** (amongst political decision makers, planners, managers, process workers, the public, those in the education system and general employees) and **multidisciplinary skills** from the fields of economics, law, technology, forestry, ecology, construction, geology, etc. Therefore, education and capacity-building in Cleaner Production are essential for its successful implementation.

Multidisciplinary approaches are not currently developed in the educational system of B&H. Curricula focus mostly on natural sciences and technology. The integral approach, which would include the economical, legal and management aspects in analysing particular questions, is almost non-existent. Furthermore, research on human and sociological issues is undertaken separately.

All university programs aimed at education in the areas that might affect natural resources (industrial production, agricultural production, mining, forestry, mechanical engineering, construction, services, etc.) must include courses in which the life cycle is integrally reviewed, and encompass all of the implications of Cleaner Production research. This can be achieved by the adjustment of existing study programs and through the development of innovative undergraduate and multidisciplinary graduate programs focussing on Cleaner Production.



THE UNIVERSITIES AND CP PROMOTION

The lack of knowledge among decision makers of environmental problems in Bosnia and Herzegovina, as well as amongst staff working in the Administration, is self-evident. It should be of concern to us, bearing in mind the fact that natural resources are important for a country's development, and preservation of such resources is a precondition for sustainability. Therefore, education on the prevention of resource degradation, contamination and destruction should be high on the agenda of university courses and specialist study programs. Current and future employees of the Administration should not perform any important political duties without being educated in this area. Skills in the integral and preventative management of natural resources are key in the decision-making process regarding sustainable development in B&H.

Universities have a very serious responsibility to raise awareness, strengthen knowledge and promote the technologies and tools that will help in the creation of an environmentally sustainable future for B&H. They must play a major role in education, research, building the basis for policies, information exchange and working with communities on Cleaner Production.

Higher education should be reorganised to provide a multidisciplinary approach throughout the university

To ensure the required multidisciplinary approach is applied in a technical way, existing higher education should be reorganised to provide a multidisciplinary approach throughout the university, and not a narrow disciplinary education as provided by a single faculty. Students should be allowed to study various disciplines; this is currently impossible as they are only allowed to use the resources of one faculty.

There is a need for the detailed reconstruction of university curricula, to exclude everything that is not in accordance with current knowledge and practices contributing to sustainable development. In this context, for each university course, it would be possible to intervene and omit the teaching of those methods or technologies that have a negative impact on natural resources and the quality of life. It is not

ethical to teach students about the theory of the sustainable use of natural resources, and at the same time, in other courses, to teach them about methods or technologies that do not include any concept of pollution prevention. Forestry, agriculture, production and other areas of engineering will not be able to successfully recover in B&H without such a change of context and working methods in higher education.

One of the ways this could be carried out would be to use a modular education system, based on an effective division of students' time – 50% of the time could be spent studying selected multidisciplinary subjects at university and 50% on creative work on applied research projects, seminars, workshops, etc., created according to the needs of potential clients (the Administration, industry, civil society, etc.).

Formal university studies today are based more on theory, and less on experimental, practical and applied work. Greater importance should be attached to practical work, laboratory practice and site demonstrations. For this reason, university partnerships with industry to create case studies and applied research are highly recommended. The objective of this method of education is to develop the capability of students to use new information and to apply it later in the workplace, improving profitability of the latter.

It is also necessary to develop a system of information exchange and publication of research results via the establishment of an inter–university information system designed to enhance cooperation with business and other potential users of the information.

Such a concept would require broad reforms and is time consuming. As Bosnia and Herzegovina has an urgent need for skilled staff, able to implement environmental sector reforms, the gap should be bridged by tailor-made training of the trainers and other capacity-building programs.

Thus, the role of the universities in the promotion of Cleaner Production should not be limited to the re-organisation of curricula, they can also offer training programs for industrial companies to improve their capacities, and also contribute through applied research.

The universities, through the development of specialised training programs with appropriate certificates, should contribute to a higher level of education (specialisation) of the current Administration staff, including: I) decision makers, who need integral and preventative management skills to make important political decisions for the sustainable development of Bosnia and Herzegovina, II) staff who will be working on the implementation of environmental laws e.g. planning, licensing and inspection, III) staff working on licensing and inspection, and iv) staff working on the monitoring of industrial emissions.

Conclusions

This paper reflects the problems encountered and the discussion that arose during the round table meeting entitled "Cleaner Production in University Curricula" that was held on January 28, 2002, within the framework of the LIFE project "Capacity Building in Cleaner Production in Bosnia and Herzegovina". The main goal of the meeting was to gather all relevant representatives from the Universities of B&H to discuss the importance of Cleaner Production and human resource development for the economic recovery of the country, and to discuss what the universities can do to promote Cleaner Production and sustainable development, especially in the context of the current university education reform, and the institutional and legal reform of the environmental area in B&H.

The participants concluded that universities should play a leading role in systematic human resource development, integrating education and research, and building partnerships with industry. The traditional narrow disciplinary approach to education has to be transformed towards a multidisciplinary education system that will produce professionals able to contribute to sustainable industrial development from an Industry and Administration perspective.

LA PRODUCTION PLUS PROPRE DANS LES PROGRAMMES D'ENSEIGNEMENT UNIVERSITAIRES

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Une table ronde intitulée « La production plus propre dans les programmes d'enseignement universitaires » a été organisée dans le cadre du projet LIFE « Renforcement des capacités de production plus propre en Bosnie-Herzégovine ». L'objectif était de rassembler les représentants des universités afin de discuter l'importance de la production plus propre et le développement des ressources humaines dans le rétablissement économique du pays.

Le futur développement industriel basé sur la production plus propre permettra à l'industrie de se rapprocher de la cible à atteindre, le développement durable ; effectivement, la production plus propre permet de réduire les rejets polluants tout en augmentant l'efficacité de l'utilisation des matières premières et de l'énergie. La production plus propre exige un **changement de comportement** et des **compétences multidisciplinaires**, l'éducation et le renforcement des capacités dans le domaine de la production plus propre sont donc des aspects essentiels à son introduction.

Ce rapport présente les problèmes rencontrés et les discussions soulevées lors de la table ronde sur le rôle des universités dans la promotion de la production plus propre.

Mots-clé : Production plus propre, rétablissement économique, coûts des déchets, développement des ressources humaines, enseignement universitaire.

LA PRODUCCIÓN MÁS LIMPIA EN LOS PLANES DE ESTUDIO UNIVERSITARIOS

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Como parte del proyecto LIFE «Refuerzo de capacidades para una producción más limpia en Bosnia-Herzegovina» se celebró una mesa redonda titulada «La producción más limpia en los planes de estudio universitarios». El objetivo de la mesa redonda era reunir a representantes de las universidades y suscitar un debate en torno a la importancia de la producción más limpia y de desarrollar los recursos humanos para propiciar la recuperación económica del país.

El desarrollo industrial futuro, basado en una producción más limpia, permitirá que la actividad industrial cumpla de manera más satisfactoria los requisitos para un desarrollo sostenible, ya que supondrá tanto una reducción de los vertidos contaminantes como un incremento del rendimiento de las materias primas y del uso energético. Dado que para la implantación de la producción más limpia se requiere un **cambio de actitud** y **habilidades multidisciplinarias**, la educación y la formación en prácticas de este tipo devienen factores esenciales para la introducción de la primera.

Este documento recoge los problemas detectados durante la mesa redonda, así como los debates llevados a cabo en torno al papel que deben desempeñar las universidades en la promoción de una producción más limpia.

Palabras clave: Producción más limpia, recuperación económica, coste de los residuos, desarrollo de recursos humanos, formación universitaria.

HAZARDOUS WASTE IN EGYPT: SOURCES AND CONTROL STRATEGY

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Hazardous waste causes serious environmental problems and is a risk to health. In Egypt these problems are exacerbated by the fact that both the population and industry are largely concentrated in specific areas. A national strategy has been set up and the National Action Programme proposed for the management of hazardous waste comprises programmes on management, minimisation, recovery, recycling and treatment of hazardous waste. Furthermore, this article presents the case of 10th of Ramadan City, the proposed installation of a solid waste management facility there, and its economic and technical feasibility.

Key words: Hazardous waste, management strategy, national action programme, minimisation, waste disposal facilities, remediation.

Introduction

Hazardous waste in Egypt causes severe environmental problems and poses serious health risks. The short and long-term effects are far more serious than those caused by municipal waste. Whilst the latter is more readily biodegradable, most industrial residues are toxic, persistent, biomagnifiable and tend to accumulate in the receiving environments.

BACKGROUND

Almost 37 percent of Egypt's population of 66 million lives in Cairo, Alexandria and the Suez Canal cities. Manufacturing and service industries in these cities as well as in other major urban centres in the Delta and Upper Egypt expose over 15 million people to hazardous and toxic releases which pose public health risks and cause severe environmental degradation. A World Bank study published in 1996 estimates that the total cost of combating pollution from industry in Egypt is about $ 1.3 billion, or about 0.4 percent of GDP over a ten-year period.

Uncontrolled discharge of hazardous contaminants results in severe degradation of air quality, build-up of toxic constituents in surface water supplies, contamination of soil and groundwater, and severe operational problems in municipal sewerage systems. In addition, open dumping of hazardous solid waste and emission of toxic gases pose serious health risks.

The estimated amounts of hazardous waste generated annually from industrial, institutional and medical sources are in the range of 150,000 - 170,000 tons. Whilst about 300 large industrial establishments contribute to an appreciable portion of the waste, the bulk of the waste is generated by over 20,000 small and medium-sized enterprises, which comprise the major part of the manufacturing industry in Egypt as well as more than 2,000 healthcare facilities ranging from large hospitals to small private clinics.

The dominance of clusters of manufacturing establishments in a few industrial centres in major urban communities and the New Industrial Cities (NICs) generate toxic waste. Hazardous

Major urban centres in the Delta and Upper Egypt expose over 15 million people to hazardous and toxic releases

particulates may be emitted as metallic oxides from spray painting, as asbestos fibres from insulation, and from special releases such as barium, beryllium, boron, lead, and arsenic from the metals-processing industry. In addition, about 1.3 billion m^3/year of polluted industrial effluents are discharged laden with varieties of bio-accumulative, persistent, and toxic chemicals.

In the Greater Cairo Area, Helwan represents one of the largest and most polluting industrial zones in the country where the cement, steel, foundries, ceramics, smelting, textile, chemicals, and military industries generate considerable amounts of hazardous waste. The lead content in air downwind from a large smelter in Helwan is fifty times that of the WHO-recommended maximum limit. Water quality in the area is affected by toxic discharges from the iron and steel, coke, basic chemicals, engineering and military industries. Shoubra El-Kheima, which lies north of Cairo, has over 1,300 establishments manufacturing metals, glass, textiles, engineering, chemicals and food products. Industrial plants in the area, which generate considerable hazardous emissions, pose serious health risks to an estimated 3 million inhabitants.

The centre of Cairo houses over 2,000 small-scale enterprises, including 330 tanneries and 12 lead smelters, which cause severe environmental degradation. The government is currently preparing a plan for relocating hazardous and polluting industries in new cities away from the congested residential areas in Greater Cairo; the new locations will be provided with centralised facilities for waste treatment.

Alexandria's manufacturing industry constitutes about 32 percent of Egypt's industrial activity. The paper, textile, metals, and engineering industries are the main contributors of hazardous waste. Hazardous effluents discharged into the city sewer system, or directly into the sea contain: chromium waste from tanneries; mercury, lead, and copper from the chemical, electronics, and metallurgical industries; oil from petroleum refining; black liquor from pulp and paper mills; and assorted toxic residues from the dyestuffs and textile finishing facilities.

In other parts of the country, small manufacturing and service establishments emanate considerable hazardous residues in the form of slags, slurries, sludge and spent liquors from pickling, anodising and electro-plating processes. Major industries, which generate hazardous residues, include petroleum refining, paint and pesticide formulation, electric and electronic components, pharmaceuticals, chemicals and textile finishing.

At present, management of hazardous waste is impeded due to the absence of incentives to minimise waste generation at source, lack of centralised facilities for recovery and treatment of waste, and scarcity of information on the sources, amounts and characteristics of waste arising from manufacturing, services, agriculture, and healthcare. The lack of an integrated waste management system and the virtual absence of secured landfill sites lead to the widespread practices of open incineration or illegal dumping with municipal waste.

Recent developments in Egypt have compounded the difficult problem of hazardous waste management. Privatisation is rapidly pursued to provide resources to bring stumbling companies back on track through injecting added investment in modernisation and expansion of the manufacturing industry. The rapid growth of industry is expected to bring a parallel rise in hazardous waste generation. In addition, enforcement of Law 4/94 in early 1998 will increase the amount of secondary generation of hazardous waste as a result of the operation of end-of-pipe treatment facilities in the polluting establishments. Both factors add to the urgency of developing a national strategy for hazardous waste management.

The lack of an integrated waste management system and the virtual absence of secured landfill sites lead to the widespread practices of open incineration or illegal dumping with municipal waste

The objectives of the national strategy on management of hazardous waste encompass:

1. Strengthening regulatory, administrative and enforcement mechanisms for hazardous waste control at the national and local levels.

2. Developing a programme of action for the management of hazardous waste to alleviate its impact on public health and environmental amenities. The priority actions to achieve the strategy objectives are:

1. To put into operation article 29 of Law 4/94, and articles 25 to 31 of ER 338/95, and to develop guidelines on packaging, labelling, storage, transport, recycling, treatment and disposal of hazardous waste. Guidelines must be based on scientific knowledge, and embody the principles of practicality, acceptability and affordability.
2. To promote the recovery of hazardous waste to alleviate pollution problems in industry, and to create new sources of raw materials. Centralised facilities should be established in major industrial centres for the reprocessing and recycling of spent materials.
3. To strengthen the capacity of national research institutions in risk management and waste minimisation, to enable the creation of an indigenous technology base capable of absorbing and assimilating foreign experiences; and to support medical research to assess the effects of toxic emissions on human health and the environment.
4. To institute financial instruments for the minimisation of hazardous waste compatible with the goals of the conservation of resources and

prevention of pollution. The environmental tax already imposed on cement reflects the price of environmental damage arising from pollution during manufacturing. The system may be extended to other products such as fertilisers, iron and steel, and basic chemicals.

5. To identify technical and economic factors related to hazardous waste control. Priority should be given to highly toxic, persistent and pathogenic waste generated from hospitals, chemical processing, and radioactive sources, particularly those subject to accumulation in the environment or assimilation in the food chain.
6. To develop a cradle-to-grave system for the management of priority hazardous waste such as those stemming from the tanning, metal plating and finishing, printing, chemical formulations, textile finishing, pulp and paper manufacturing, and metallurgical industries.
7. To put into operation a network for information services on hazardous waste sources, characteristics, amounts, and procedures for recovery and treatment. The network should eventually operate as a commercial clearinghouse to link potentially interested users with generators of hazardous waste.
8. To promote the development of human resources for hazardous waste management. On-the-job workshops and group seminars on technologies for in-situ reduction of hazardous waste, and the proper handling of generated waste, should be tailor-made to meet the needs of major waste-generating sectors.
9. To strengthen public awareness and enhance the flow of information from industry and government to the public, and vice versa.
10. To promote private investment in waste management through establishing joint-venture companies for the transport of hazardous waste, centralised recovery and waste treatment.

AN OUTLINE FOR A NATIONAL ACTION PROGRAMME FOR THE MANAGEMENT OF HAZARDOUS WASTE

The proposed programme of action for the containment of hazardous waste in Egypt comprises the following components:

1. Putting into Operation the Regulatory and Voluntary Systems for Hazardous Waste Control

The Problem

Despite instituting an elaborate regulatory system for permitting, collecting, storing, transporting, treating, disposing of and monitoring handling of hazardous substances and waste (Articles 25 to 31 of ER 338/95), enforcing these regulations is expected to face serious problems and shortcomings. Among the apparent obstacles are the vastness and complexity of substances and waste subject to control, the conflicting jurisdiction of the competent enforcement agencies, lack of information on sources, the magnitude of the problem, and the potential negative influence of external economic and political forces.

The approach to regulations varies among the competent agencies, primarily as a result of variations in agency structure and differences in statutory mandates and their interpretation. In an effort to expedite the resolution of the inherent complexity of the enforcement mechanism, Law 4/94 mandated collaboration among all the agencies concerned, with the EEAA as the lead coordinating body.

Programme Description

The incomplete understanding of the nature and extent of health and environmental risks for many hazardous substances hampers effective risk management. The inadequate analytical facilities of the research institutions limit risk-assessment studies. Whilst numerous hazardous substances and waste are being used in Egypt, epidemiological studies on their impact on the exposed population leave much to be desired.

The effective enforcement of hazardous waste regulations is expected to face a major roadblock due to the absence of designated disposal sites and specialised waste handling entities. In addition, operationalising the regulation requires detailed categorisation of generators subject to permitting and conditional exemption, listing of exempt recycled hazardous waste, procedure for de-listing of hazardous substances and other relevant issues.

The effective enforcement of hazardous waste regulations is expected to face a major roadblock due to the absence of designated disposal sites and specialised waste handling entities

Activities

- Strengthening institutional capacity for permitting and enforcement
  1) Develop operational guidance for cradle-to-grave control of hazardous substances and waste.
  2) Issue lists of hazardous waste subject to permitting and control, particularly extremely hazardous waste that could have serious, irreversible effects on health from a single exposure event.
  3) Issue directives on categories of waste generators subject to permitting (conditionally exempt, Medium Quantity Generators MQGs subject to limited control, Large Quantity Generators LQGs subject to full control, and waste recovery and treatment facilities), and issue 2,000 to 3,000 permits by the end of the year 2005.
  4) Issue licensing procedures for entities involved in the collection, transport, storage, and disposal of hazardous waste.
  5) Establish a de-listing system.

- Capacity-Building Activities
  1) Support risk-assessment activities in 5 to 7 national research institutions and universities, to develop an indigenous capacity for risk management and assessment.
  2) Complete epidemiological surveys of the 10 most dominant hazardous wastes by the year 2005.
  3) Convene 3 workshops for training personnel from line Ministries, EMUs, and RBOs on enforcement, monitoring and licensing procedures of hazardous substances and waste.

- Public Awareness and Partnership Programmes
  1) Develop Responsible Care Programmes for the chemical, engineering, metallurgical, and textile industries.
  2) Instate the Star Programme for LQGs achieving 50 percent reduction of hazardous waste generation, and select 5 to 7 representative enterprises.
  3) Develop a mechanism for the Public Right to Know by the year 2005 for dissemination of information regarding complying and violating institutions, achievements in the waste management field, and the health and environmental impacts of hazardous waste.

2. Programme on Minimisation of Industrial Hazardous Waste

The Problem

Industrial hazardous waste includes assorted residues from substances employed as solvents; halogenated organics, tempering salts, mineral oils and oily substances; substances containing PCBs, inks, dyes, pigments, paints, lacquers, varnish, resins, latex, plasticiser, metallic dust, spent catalyst materials; liquids or sludge containing metals; and contaminated containers. Hospitals generate infectious and pathological waste, contaminated articles, toxic chemicals and unused pharmaceuticals, and radioactive waste generated from diagnostic and treatment applications.

Waste minimisation involves reduction, to the extent feasible, of any waste generated, which would otherwise be subsequently treated, stored or disposed of

Programme Description

Waste minimisation involves reduction, to the extent feasible, of any waste generated, which would otherwise be subsequently treated, stored or disposed of. This may be achieved through the reduction of the total volume or quantity of the generated waste, or the reduction of the toxicity of the waste, or both. Alternatives for reducing waste generation at source include: integration and rational use of process inputs, installation of new equipment, modification, adaptation or improvement of production processes, and upgrading production efficiency.

Despite the existence of numerous opportunities to minimise generation of hazardous waste in the Egyptian manufacturing industry, little has been achieved so far. Factors likely to affect waste minimisation in the future include continued escalation of the costs of raw materials, concerns over liability, and the enforcement of hazardous waste regulations in early 1998. An integrated approach to hazardous waste minimisation involves: the identification of priority toxic pollutants and hazardous waste streams, the development of selective reaction technologies and alternate synthesis pathways to reduce generation at source, and the development of process analysis methods which consider waste minimisation as an integral part of equipment design.

Activities

- Identify pollution prevention and hazardous waste minimisation opportunities in 40 facilities preferably to be selected from amongst the EEAA's list of major polluters
  1) Identification and quantification of all sources of gaseous, liquid, and solid pollution.

2) Propose measures to adjust operating procedures to minimise hazardous waste generation.
3) Assess existing procedures and possible improvements for containment of spills and prevention of leakage.
4) Suggest measures to improve maintenance, and optimise the use of production inputs.
5) Propose measures to improve housekeeping procedures and tidiness of production facilities.
6) Assess whether storing hazardous materials on-site is done in a manner commensurate with the hazards they pose, and with regulatory requirements Law 4/94.
7) Develop a system for identification, categorisation and separation of hazardous waste according to regulatory requirements.
8) Evaluate whether documentation of on-site storage, transport, and disposal activities is being undertaken in accordance with the requirements of Law 4/94, and if existing recording procedures allow the appropriate tracking of waste consignments destined for off-site disposal.

- Develop an action plan for the management of hazardous waste in 15 to 20 facilities representing dominant sub-sectors of major polluting industries. The plan should include:
  1) Internal system for management of hazardous waste
  2) Compliance status with pertinent environmental laws
  3) Financial plan for the proposed waste management activities
  4) Cost/benefit analysis
  5) Self monitoring system

Centralised schemes for waste recovery do not exist in Egypt

- Implementation of demonstration projects
  1) Implementation of six demonstration projects in selected facilities representing the petroleum refining, fertilisers, pulp and paper, engineering, textile finishing, and metallurgical industries.
  2) Developing guidelines for hazardous waste minimisation in the above sectors.
  3) Convening dissemination events (seminars/workshops) to demonstrate appropriate means for waste reduction for other facilities in the respective sectors.

3. Programme on Recovery and Recycling of Industrial Hazardous Waste

The Problem

Recycling consists of recovering waste by-products, and their use as raw materials for the same or other processes. As the costs of raw material, waste treatment and disposal continue to rise, the recycling of industrial hazardous waste will become more profitable. However, decisions concerning a proper recovery scheme cannot be made rationally on an economic basis alone, as ecological and technological factors must also be considered in selecting methods of recovery and re-utilisation of hazardous waste.

Centralised schemes for waste recovery do not exist in Egypt. Their establishment in major industrial centres may serve large-scale facilities as well as many small quantity generators (SQGs) in nearby locations. Such schemes can overcome two particular problems: (a) the unavailability of land space for installation of on-site waste recovery facilities, and (b) the fact that SQGs can ill afford to implement sophisticated and expensive on-site waste recovery systems.

Programme Description

Waste recovery schemes for spent oils, catalysts, solvents, acids and alkalis and precious metals may be installed in locations where such hazardous wastes are generated in large amounts. As most of these operations may not be economical when handled by the individual waste generators, reprocessing and purification in a centralised facility may prove technically and economically feasible.

A probable obstacle to establishing centralised recovery schemes is the emergence of a pollution control industry, particularly incineration, which may hinder efforts for hazardous waste recovery and recycling. Another obstacle is the non-selectivity of most of the current technology available for recycling hazardous waste, which limits their ability to remove specific solutes from complex mixtures. However, on-site segregation of waste streams and/or applying simple separation technologies in-situ could significantly improve selective recovery of hazardous waste in centralised facilities.

Activities

- Establishing a national clearing-house on waste exchange by the year 2000.
  1) Identify sources, amounts and characteristics of hazardous waste generated from LQGs based on information available in line ministries, the Egyptian Federation of Industry, and the Industrial Pollution Control (IPC) models of the World Bank.
  2) Establish communication between potential users and generators of hazardous waste.
  3) Institute a charging system to enable the operation of the system on a commercial basis.

- Promote the establishment of four centralised facilities for hazardous waste recovery and recycling in major industrial centres by the year 2002.
  1) Recovery of acid pickling waste in Helwan.
  2) Integration of a chromium recovery facility in the relocation scheme of Cairo tanneries in Badr city.
  3) Recovery of solvents in Alexandria.
  4) Operation of small-scale precious metals recovery units in selected locations.

- Development of technical assistance programme.
  1) Provide advice on available and cost-effective recovery technologies for SQGs.
  2) Conduct specialised training on waste reprocessing technologies.
  3) Support market surveys for waste which can be recycled.

Unwarranted harmful health and environmental impacts are threatening the exposed communities

4. Programme on Hazardous Waste Treatment

The Problem

Incineration, drying, and other physical separation technologies are often employed to treat hazardous waste generated from Egyptian industry. Neutralisation, and to a lesser extent, cyanide oxidation and biological treatment are practised in few industrial facilities. Improper treatment practices have resulted in contamination of soil, water streams and air sheds. Consequently, unwarranted harmful health and environmental impacts are threatening the exposed communities. Waste treatment by thermal degradation (pyrolisis or incineration) requires a careful evaluation of the trade-offs of one toxic substance for another.

Programme Description

Physical treatment techniques employed by major industrial facilities include lagooning, sludge drying, and prolonged storage in tanks. More sophisticated methods being applied on a limited scale include air flotation, centrifugation and distillation. Solidification

or fixation processes, which convert the waste into an insoluble, rock-hard material, are not used in Egypt. Incineration of hospital waste is mandated in Egypt, and incinerators are locally manufactured, though modification of the technology may be needed to meet the emission requirements of Law 4/94.

Chemical treatment methods are commonly used to effect the complete breakdown of hazardous waste into non-toxic gases and, more usually, to modify the chemical properties of the waste, e.g. to reduce water solubility or to neutralise acidity or alkalinity. Cyanide oxidation, heavy metal precipitation and chrome reduction are practised in few installations in Egypt. In-plant biological treatment of phenolic waste and oily waste has been successfully practised in Egypt, and bacteria were developed to selectively treat these toxic wastes.

Activities

- Construct and operate on-site Treatment Facilities for Hazardous Waste.
  1) Secure access to low-interest financing for hazardous waste treatment in 50 to 60 major waste-generating industries through KFW, the World Bank and other donor-sponsored pollution abatement projects throughout the year 2004.
  2) Establishing two commercial centralised facilities for the treatment of hazardous waste from SQGs in Cairo and Alexandria, with shared financing from private sources, the banking system, and SFD by the year 2000.
- Establish Technical Support Services.
  1) Provide consulting services for selection of industry-specific hazardous waste treatment technologies.
  2) Implement training programmes on the operation and maintenance of waste treatment facilities.
  3) Develop guidelines for self-monitoring of treatment facilities in industry, hospitals and other waste generating establishments.

5. Providing Assistance for Local Government to Establish Hazardous Waste Disposal Facilities

The Problem

Establishing disposal facilities by local government in compliance with Law 4/94 is still hampered by the uncertainty of potential risks to public health and the environment, and by the extreme lack of equipment, expertise and suitable sites necessary to handle hazardous waste. As a result, no hazardous waste landfill (HWL) has been established in the country. This awkward situation is certain to hinder the enforcement of Article 28- item 5 of ER 338/95 (Treatment and disposal of hazardous waste).

Programme Description

Installation of HWLs requires extensive studies and large investments to ensure conformity with regulatory requirements and the protection of environmental amenities. Groundwater quality could be impacted by leachates from the HWL installation. The location and quality of nearby underlying aquifers must therefore be considered during site selection. The HWL must be located outside historic flood plains. The air quality in the vicinity of the site must be periodically monitored and controlled to ensure compliance with the applicable standards and to minimise objectionable emissions. The base of the landfill should be well above the saturated zone. Landfill sites ideally should be in climates with low rainfall and high surface evaporation rates.

The topography should prevent standing water from forming on flat land, and also prevent erosion and runoff from sites with excessive sloping. Soil permeability at the site is generally the major factor affecting the rate of contaminant transport through the soil once the landfill begins leaking.

Technical and financial assistance should be provided to enable municipalities of major urban centres to establish HWLs

Soil texture plays an important role in permeability. The pH of the soil is also a consideration, since solubility of metals is inversely proportional to soil acidity. Other factors to consider in site selection include normal prevailing wind direction, proximity of the waste source to the site, accessibility for transportation, availability of soils for cover material, and the size and complexity of the landfill.

Considering the above stringent requirements, in addition to the lack of financial resources, and the scarcity of expertise, local initiatives to establish HWLs have been impeded. Therefore, technical and financial assistance should be provided to enable municipalities of major urban centres to establish HWLs. Operation of such facilities could be self-financed through charges imposed on those waste generators that would benefit.

Activities

- Provision of Technical Assistance for Establishing Secured Hazardous Waste Landfills
  1) Develop detailed guidelines for site selection, design, construction, operation and monitoring of local HWLs.
  2) Provide technical assistance for the design of waste-specific containment facilities.
  3) Provide administrative support for the local administrations in obtaining the necessary clearances for the selected sites from the competent ministries and military authorities.
  4) Help in securing financing for the construction and operation of 3 to 5 HWLs in Cairo, Alexandria and Suez.

6. Identifying Priority Contaminated Sites and Remediation of Top Priority Sites

The Problem

A significant portion of the hazardous waste in Egypt is still disposed of in open dumps, municipal landfills or in interim storage sites within the manufacturing premises. In the absence of bio-degradation, the persistent toxic pollutants accumulate and result in significant soil and water contamination. Leaky storage facilities, spills and illegal disposal of off-specification toxic products are causing irreversible damage to the receiving environments.

Programme Description

The accumulation of toxic contaminants, due to improper open storage and disposal practices, has caused extensive pollution in several industrial sites. The most notable ones are the sites of Miser Chemical Company MCI (Mercury) and Egyptian Plastics and Electric Industries EPI (Lead) in Alexandria, and the General Metals GEMT (Lead) and the Tanneries Complex (Chromium) in Cairo. Other unidentified contaminated sites are believed to exist in industrial centres, domestic dumping sites, oil storage facilities, and service stations.

To illustrate the gravity of the problem, staggering levels of contamination of the walls, ceilings, and floors of the MCI, the abundant mercury cell houses, of up to 12.2 g Hg/kg have been found. Remediation of this site requires an investment of EGP 40 million for the demolition of structures and dismantling of contaminated production units and the disposal of mercury-contaminated construction debris, equipment, materials and other contaminated tools in specially designed secure landfill in an off-site location. Selection of the burial site should be free from faults or cracks, far from surface and ground water bodies, located away from environmentally sensitive areas and at least 3 km away from settlements and housing areas as stipulated in Law 4/94.

Staggering levels of contamination of the walls, ceilings, and floors of the abundant mercury cell houses, of up to 12.2 g Hg/kg have been found

Activities

- Identifying Priority Hazardous Waste Dumping Sites
  1) Compile basic data in collaboration with line ministries on abundant and existing contaminated sites.
  2) Screen the initial list of suspected sites.
  3) Inspect and conduct analytical surveys for 10 to 15 priority sites, which pose serious public health or environmental risks by December 2005.
  4) Formulate remediation plans for up to 8 short-listed priority sites by December 2003.

- Implement Remediation Projects in Top Priority Sites
  1) Complete remediation project of MCI by June 1998 (KFW).
  2) Complete remediation project of the PEI site in Alexandria by June 2002 (KFW).
  3) Complete remediation project of GEMT site in Tibben (WB/USAID) in 2001.

10TH OF RAMADAN CITY

Establishing Hazardous Waste Containment Facility in the 10th of Ramadan City: Case Study

The rapid development of industry in Egypt over the past 20 years has resulted in establishing 11 new industrial cities (NICs), with 5 under construction. Total investment in the 2,500 operating industrial facilities in the NICs has so far exceeded $ 3 Billion. An additional 33 NICs are planned up to the year 2107.

Solid waste of hazardous and non-hazardous origins are co-disposed of with domestic waste at dumping sites, which do not conform to the specifications of Environmental Law 4/94. Whilst solid waste in NICs are generated, in part, by few large industries, the bulk of the problem is attributed to the small and medium-sized industries, which comprise the major part of manufacturing activities in these cities. Uncontrolled discharge of hazardous contaminants from NICs results in the build-up of toxic constituents in the environment, contamination of groundwater, and severe operational troubles in the sewerage networks and wastewater treatment plants. In addition, incineration of hazardous residues, which is being practised in most cities, generates toxic emissions that pose serious health risks.

Community services in NICs typically include schools, markets, healthcare facilities, transport networks, sewerage systems, and privately managed systems for the collection and disposal of solid waste.

A fast-track programme for the environmental rehabilitation of NICs in Egypt is presently being implemented under the auspices of the Ministry of State for Environmental Affairs. The NICs rising pollution problems pose environmental challenges in these industry-intensive communities. Escalating pollution control costs, in addition to concerns about environmental quality and public health, have spurred the government to pursue this initiative. The Environment Friendly Industrial Cities Programme (EFNIC) constitutes a public-private partnership between business, government and the community.

The incineration of hazardous residues, which is being practised in most cities, generates toxic emissions that pose serious health risks

Investment in pollution prevention in the five cities participating in the programme has so far exceeded $500 million. Within the context of the EFNICs programme, partnerships in pollution prevention have been fostered on a regional basis encompassing several industrial cities. The first phase of the programme, scheduled for completion by December 2000, involves 5 cities, namely the 10th of Ramadan, 6th of October, El Sadat, El Obour, and Borg El-Arab cities.

NICs participating in the programme are expected to provide conducive and productive environments for its manufacturing establishments, and support activities and inhabitants without imposing unsustainable demands on local resources and infrastructural services.

A candidate city in this sense is one that meets multiple goals. These broad goals include healthy living in residential districts, a suitable work environment in production plants, industrial emissions that comply with pertinent regulations, and an ambient environment that meets the Egyptian quality standards.

Solid Waste Management in the 10th of Ramadan City: A brief outlook

With the magnitude of waste disposal problems facing the 10th of Ramadan, efforts are focused on achieving maximum reduction of pollutants at minimum cost. This can be attained through establishing a centralised waste treatment facility to enable process efficiency, economy of scale, better response to future expansions, flexibility to meet the needs of intermittent operations, and possible recovery and re-use of materials. The disadvantages of treatment of hazardous waste for small quantity generators (SQGs) are high capital and operating costs, low-volume operating levels, and the unavailability of expertise to operate individual treatment units.

Effective management must benefit from centralisation, where industrial residues from separate but compatible sources can be brought together to a centralised facility for treatment. The following factors should be considered when developing specific programmes for centralised reclamation of industrial residues:

1. Availability of temporary on-site storage facilities for hazardous waste
2. Ease of transportation and handling
3. Compatibility for treatment with other waste
4. Marketability of recovered materials

Centralised recovery of valuable substances from solid residues should not be overlooked in developing a centralised scheme for the management of industrial waste. Decisions concerning a proper recovery scheme cannot be made rationally on an economic basis alone, as ecological and technological factors must also be considered in selecting methods of recovery and re-utilisation of industrial waste.

Waste disposal efforts are focused on achieving maximum reduction of pollutants at minimum cost

In all cases a reasonable fee would be collected from the waste generators, depending upon the quantity and quality of residues, and the type of treatment needed.

The centralised scheme should be suitable for implementation as it can overcome two particular problems:

I. Unavailability of on-site land space, which prevents installation of waste-treatment facilities at production locations, and
II. Industrial facilities, particularly small quantity generators, can ill afford to implement sophisticated and expensive on-site waste treatment and/or recovery systems.

At present, large amounts of potentially recyclable solid waste are either dumped in an improper way or stockpiled in the 10th of Ramadan City. In a few instances, hazardous waste is intentionally dumped in the sewer system. The operator often has no other alternative for appropriate disposal of this unwanted waste. Solid waste of a hazardous and non-hazardous nature commonly found in the 10th of Ramadan include:

1. Off-specification products;
2. Chemicals used in production whose date for appropriate use has expired;
3. Materials spilled, lost or having undergone other mishaps including any materials, equipment etc. contaminated as a result of the mishap;
4. Materials contaminated or soiled as a result of planned actions (e.g. residues from cleaning operations, packing materials, containers);

5. Unusable parts (e.g. exhausted catalyst);
6. Substances which no longer perform satisfactorily (e.g. contaminated acids, contaminated solvents);
7. Residues from industrial processes (e.g. still bottoms);
8. Residues from pollution abatement processes (e.g. scrubber sludge, baghouse dusts, spent filters);
9. Machining/finishing residues (e.g. lathe turnings, mill scales); and
10. Residues from raw materials processing.

The hazardous constituents in the form of liquid or sludge may include:

1. Residues from substances employed as solvents;
2. Halogenated organic substances not employed as solvents;
3. Tempering salts containing cyanide;
4. Mineral oils and oily substances (e.g. cutting sludges);
5. Oil/water, hydrocarbon/water mixtures, emulsions;
6. Substances containing PCBs and/or PCTs;
7. Inks, dyes, pigments, paints, lacquers, varnish;
8. Resins, latex, plasticisers, glues/adhesives;
9. Pyrotechnics and other explosive materials;
10. Non-halogenated organic substances not employed as solvents;
11. Inorganic substances without metals;
12. Ashes and/or cinders;
13. Non-cyanidic tempering salts;
14. Metallic dust, powder;
15. Spent catalyst materials;
16. Liquids or sludge containing metals;
17. Residue from cleaning of tanks and/or equipment; and
18. Contaminated containers (e.g. packaging, gas cylinders, etc.).

Present unacceptable practices for handling solid waste require the establishment of a centralised management facility

Among the diverse waste recovery options, the following are identified as potential operations for resource recovery, recycling, reclamation or direct reuse of industrial waste in the 10th of Ramadan City. Most of these operations may not be economic when handled by the individual generators. However, their recovery and reprocessing in a centralised facility may prove profitable.

1. Use as a fuel or other means to generate energy;
2. Solvent reclamation/regeneration;
3. Recycling/reclamation of organic substances which are not used as solvents;
4. Recycling/reclamation of metals and metal compounds;
5. Recycling/reclamation of other inorganic materials;
6. Regeneration of acids or bases;
7. Recovery of components from catalysts; and
8. Oil re-refining or other re-uses of oil.

The present unacceptable practices for handling solid waste in the 10th of Ramadan City require the establishment of a centralised facility for the management of both hazardous and non-hazardous solid waste. The broad objectives of the system encompass:

1. Encouraging reuse and recycling of recovered resources whenever technically and economically feasible.
2. Enabling cost-effective handling and disposal of waste generated within the city. The service may be extended in the future to cover other nearby industrial areas such as the cities of Suez, Ismailia, Badr, and Obour.
3. Discouraging open incineration or improper dumping of hazardous waste to alleviate air pollution problems and illegal discharge of harmful substances in the municipal sewer systems.
4. Promoting investment in waste reclamation, possibly through major contributions by the benefiting industrial facilities.

The proposed solid waste management facility (SWMF) in the 10th of Ramadan will be responsible for collecting, transporting, storing, sorting, reprocessing, and disposing of industrial and residential solid waste in accordance with the regulations stipulated in Environmental Law 4/1994.

The investment needed for establishing a SWMF capable of handling both

non-hazardous waste from industrial, commercial and residential sources generated in the 10th of Ramadan (8,000-10,000 tons/month), and hazardous industrial residues (400-700 tons/month) is estimated in the range of EGP 10 million in **the first phase** (Establishing landfill sites and operation of the collection and transport systems).

The investment required for **the second phase**, which involves establishing specialised facilities for waste recovery, reprocessing and incineration, may reach EGP 100 million based on the Finnish estimates of investment required for a hazardous waste reprocessing and containment facility (EKOKEM OY AB, Riihimaki). The specialised facility may include:

I. An incineration plant which processes organic hazardous waste at >1,300 °C with potential energy generation,
II. Physicochemical centralised facility for treatment of inorganic waste such as cyanides and metal plating waste, and
III. Secured landfill where filter cakes, dust and slag generated from the incineration and physicochemical treatments are disposed of.

The proposed SWMF should be provided with an effective emission control system. Emissions of the incineration process may include polyaromatic hydrocarbons, NO_X, CO, HF, TCDD, dust, and metal gases. These hazardous gases must be totally removed in a proper and safe manner. The environmental monitoring programme of SWMF should include measurements of the flue gas emissions of the incinerator, monitoring of fugitive gases, surveillance of the work environment and monitoring of the wastewater discharged from the plant.

The investment required for both phases may reach EGP 110 million

Assessing Economic and Technical Feasibility of Establishing an SWMF

A fully-fledged study is presently being undertaken to assess the technical-economic feasibility of a project, which encompasses the establishment of an SWMF for the collection, transport, sorting, storage, reprocessing, incineration, and disposal of solid hazardous and non-hazardous waste for the 10th of Ramadan City.

The feasibility study will identify major sources of solid waste generation in industrial, commercial, and residential areas. The proposed priority activities of the study encompass: developing institutional structures including technical and administrative systems; updating the preliminary standing study and conceptual design developed by the local consultants; preparing an environmental impact assessment of the designated site; and implementing a comprehensive economic and financial study. The study should clearly identify all potential stakeholders, responsibilities and roles in managing the SWMF.

The assessment comprises the following:

- Identifying and applying a system for the categorisation of solid hazardous and non-hazardous waste in the 10th of Ramadan.
- Updating the survey information gathered as part of the auditing and

follow up activities of the local experts within the scope of EFNICs programme.
- Evaluating the existing practices for on-site collection, transport and disposal of solid waste in the city.
- Describing the potential environmental and health risks associated with present management systems of both hazardous and non-hazardous waste.
- Based on the field information gathered and the database and GIS systems of the EFNICs programme, proposing technological and management alternatives for a SWMF for the 10th of Ramadan, and potential expansion of the facility to serve both the Greater Cairo and Suez Canal regions in the future.
- Implementing an environmental impact assessment study of the designated site for the SWMF.
- Performing detailed financial and economic analysis of the selected waste management options.

Definition and Categorisation of Solid Waste
- Definition of hazardous waste according to Environmental Law 4/94, USEPA and the Basel convention.
- Development of a waste categorisation system for major industrial activities in the 10th of Ramadan.

Survey of Sources and Estimates of Waste Generated
- Review of available information of the database and GIS on type of production, size, types and estimates of waste generated, location, etc.
- Estimates of expected rate of increase of waste generation based on development plans for residential, commercial and industrial activities in the city.
- Assessment of present collection, transportation, and disposal practices of both hazardous and non-hazardous waste.
- Identification of existing practices of solid waste recovery and reprocessing of marketable materials and suggestions for upgrading.

Evaluation of health and environmental hazards of present waste management practices
- Potential health risks for waste workers, scavengers, etc.
- Effects on sewer network and central wastewater treatment works.
- Soil and groundwater pollution.

Technical Analysis
- Priority hazardous waste for containment and landfilling.
- Geographical area to be covered at present and in the future.
- Standing analysis including an environmental impact assessment in accordance with the Egyptian guidelines.
- Identification of collection equipment and transportation fleet.
- Developing guidelines for at-source handling and storage of hazardous waste.
- Detailed design of the sanitary landfill for municipal and non-hazardous industrial solid waste and containment facility for hazardous waste.
- Options for waste recovery and reprocessing, including identification of processes, suppliers, and potential market demands of the reprocessed residues.

Economic and Financial Analysis
- Estimation of detailed capital investment costs for the first phase (landfilling) and the second phase (recovery and reprocessing).
- Identification of practical economic incentives based on existing studies and EEAA initiatives on the subject (the 6th October study), and potential market-based instruments for an economically viable waste management system.
- Assessment of options for donor assistance or foreign investment to hedge risks for the private investors.
- Estimation of costs for the various components of the waste management system.
- (Collection, transportation, sorting, storage, recovery, and final disposal).
- Proposing an equitable service charge system for both the industrial and residential sectors.
- Identifying actions for the long-term financial sustainability of the SWMF.

DÉCHETS DANGEREUX EN ÉGYPTE : SOURCES ET STRATÉGIE DE CONTRÔLE

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Les déchets dangereux entraînent de graves problèmes environnementaux et constituent un risque pour la santé. En Égypte, ces problèmes sont exacerbés car la population et l'industrie sont fortement concentrés dans des zones spécifiques. Une stratégie nationale a été adoptée récemment, et le Plan national d'action proposé pour la gestion des déchets dangereux comprend des programmes sur la gestion, la minimisation, la récupération, le recyclage et le traitement des déchets dangereux. Cet article présente également le cas de la ville 10 du Ramadan, l'éventuelle future installation de gestion des déchets solides, et sa faisabilité économique et technique.

Mots-clé : Déchets dangereux, stratégie de gestion, Programme national d'action, minimisation, installations d'élimination des déchets, réhabilitation de site.

RESIDUOS PELIGROSOS EN EGIPTO: FUENTES Y ESTRATEGIA DE CONTROL

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Los residuos peligrosos son fuente de graves problemas ambientales y un riesgo para la salud. En Egipto, estos problemas se ven exacerbados por el hecho de que la población y la industria se concentran en zonas específicas. Recientemente se ha adoptado una estrategia nacional y el Programa de Acción Nacional propuesto para la gestión de los residuos tóxicos y peligrosos comprende programas de gestión, minimización, recuperación, reciclaje y tratamiento de los residuos peligrosos. Además, este artículo presenta el caso de la ciudad 10 de Ramadán, la instalación para la gestión de residuos sólidos que se ha propuesto crear en dicha zona y su viabilidad económica y técnica.

Palabras clave: Residuos peligrosos, estrategia de gestión, Programa de Acción Nacional, minimización, instalaciones para la eliminación de residuos, remediación.

DEOM : UN INSTRUMENT AU SERVICE DE LA STRATÉGIE CORPORATIVE DE L'ENTREPRISE

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Lorsqu'il s'agit de concevoir la stratégie corporative d'une entreprise, les questions environnementales jouent déjà un rôle important. Que l'entreprise choisisse une stratégie de leadership en coûts ou qu'elle décide de poursuivre une stratégie de différentiation, la façon d'aborder la gestion de l'environnement doit faire partie de la stratégie globale, de façon inéluctable, via l'utilisation d'instruments adaptés à chaque situation. Dans les deux cas, mais de façon plus frappante pour ceux qui souhaitent être leaders en coûts, le Diagnostic Environnemental des Opportunités de Minimisation (DEOM) peut être un instrument très puissant pour identifier des sources potentielles d'économie.

Mots-clé : Leadership en coûts, différenciation, avantage compétitif, stratégie générique, éco-innovation, système de gestion de l'environnement, DEOM, éco-efficacité, bonnes pratiques environnementales.

Introduction

La protection de l'environnement a toujours été déliée au développement des sociétés. Ceci est mis en évidence dans l'affirmation valide il y a encore peu déclarant que les impacts environnementaux produits par le développement industriel étaient considérés comme de « petits ennuis » accompagnant tout progrès. De même, l'utilisation de l'indicateur du poids moyen des déchets domestiques par habitant et par jour comme indicateur de progrès d'une société est très récente.

Nous sommes aujourd'hui dans une période de changements, et bien que le concept de développement durable soit de plus en plus utilisé dans notre vocabulaire, il est également vrai que son histoire est encore très récente, et son application, très limitée.

L'objet de cet article n'est pas de revenir sur le concept du développement durable, mais plutôt de l'utiliser comme point de départ pour examiner comment de nouveaux outils pour la gestion de l'environnement dans les entreprises peuvent être développés à partir de celui-ci. Ce concept sert également à évaluer comment l'utilisation de ces outils peut aider à intégrer les différents concepts à la base du développement durable, c'est à dire le développement de l'entreprise, les facteurs sociaux et, comme nous le verrons de façon plus détaillée, la protection de l'environnement. Nous utiliserons, cette fois-ci, une approche stratégique.

L'AVANTAGE COMPÉTITIF – STRATÉGIES ET INSTRUMENTS DISPONIBLES

Michael E. Porter[1] définit le terme « stratégie » comme « *la recherche d'une position compétitive favorable (...) et durable* ». Selon Xavier Gimbert[2], cette définition met en lumière deux aspects :
« *Une entreprise dotée d'un avantage compétitif doit avoir une position compétitive favorable. En conséquence, elle doit présenter une caractéristique-clé et exclusive sur le marché* ». Le deuxième aspect à remarquer est que l'entreprise « *doit posséder une caractéristique-clé sur le marché afin de durer* ». Pour atteindre cette position compétitive favorable, l'entreprise doit donc posséder ce petit quelque chose qui la différencie des autres, et cette différence doit pouvoir se prolonger dans le temps. Ainsi, par exemple, les brevets d'invention aident l'entreprise à se protéger pendant quelques années afin de conserver l'exclusivité sur un nouveau produit.

Si l'obtention d'un avantage compétitif durable est clairement souhaitable, cela n'est pas toujours possible. Il faut définir dans ce cas une nouvelle stratégie de gestion destinée à créer ou essayer de maintenir cet avantage compétitif. Pour réussir, Michael E. Porter[3] définit les voies qui vont permettre à une entreprise d'obtenir cet avantage. On parle de ces voies comme de « *stratégies génériques* ». L'auteur définit trois stratégies génériques ; vous trouverez un schéma de celles-ci dans la table 1.

Différenciation : un service ou un produit supérieur à ceux de la concurrence et durable

Si une entreprise choisit la voie de la différenciation, elle devra proposer un service ou un produit supérieur à ceux de la concurrence, durable, et le faire savoir à ses clients. Une entreprise peut choisir l'aspect qui la différenciera des autres parmi un ensemble de possibilités (innovation, dessin, technologie, qualité, etc.).

En revanche, si une entreprise décide d'être leader en coûts, la situation est bien différente. Dans ce cas, l'entreprise ne cherche pas à se faire remarquer par un aspect concret, mais plutôt en proposant un produit ou un service aux caractéristiques semblables à celles de la plupart des concurrents, mais à un coût inférieur (au coût le plus bas du marché). Il est important de préciser qu'il ne s'agit pas de réduire la qualité du produit ou du service proposé mais de maintenir les performances minimales exigibles. L'une des sources favorisant cette position a son origine dans la gestion de l'entreprise.

La troisième voie est choisie par les entreprises qui décident de suivre l'une des deux stratégies génériques précédentes, mais sur la base d'une partie du marché (un segment du marché ou une zone géographique).

1 Michael E. Porter. *Ventaja competitiva*. Compañía Editorial Continental. Mexique. (1985).
2 Xavier Gimbert. *El enfoque estratégico de la empresa: principios y esquemas básicos*. Ediciones Deusto. Bilbao. (1998).
3 Michael E. Porter. *Estrategia competitiva*. Compañía Editorial Continental. Mexique. (1982).

Table 1 : Les stratégies génériques

		AVANTAGE STRATÉGIQUE	
		Exclusivité perçue par le client	**Position de coût bas**
OBJECTIF STRATÉGIQUE	Tout le secteur	Différenciation	Leadership en coûts
	Une partie du secteur	Cadrage ou haute segmentation	

Une série d'instruments adaptée aux deux cas (différenciation ou leadership en coûts) a été développée : ceux-ci peuvent aider les entreprises à intégrer la protection de l'environnement dans leur gestion sans modifier leur stratégie.

Ainsi, les entreprises ayant adopté la stratégie générique de la différenciation et qui ont pour objectif de se différencier sur le marché via une certaine caractéristique les distinguant des autres ont à leur disposition des outils qui les aident à être perçues différemment. Parmi les outils les plus connus on trouve les systèmes de gestion de l'environnement, lesquels permettent non seulement une meilleure gestion des affaires liées à la protection de l'environnement dans l'entreprise, mais également, via le processus de certification, la reconnaissance publique d'un standard déterminé par une norme. D'autres instruments intéressants sont ceux relevant de l'éco-innovation, comme par exemple l'analyse du cycle de vie ou d'autres instruments liés au produit.

Pour les entreprises qui souhaitent être reconnues comme leaders en coûts, les outils les plus importants sont ceux qui cherchent à atteindre le même objectif, c'est-à-dire la réduction des coûts. Il est bien connu que « *rendre une organisation écologique implique certains coûts (...) mais l'entreprise qui renonce à être écologique devra assumer par la suite des coûts encore plus élevés* »[4]. Évidemment, les systèmes de gestion de l'environnement sont également des instruments tout à fait adaptés à cette typologie d'entreprises car ils aident à développer une meilleure gestion de l'environnement, et une meilleure gestion devrait permettre d'identifier les inefficacités. Cependant, les instruments les plus efficaces permettant à ces entreprises de façon plus évidente de procéder à une véritable intégration de la gestion de l'environnement sont ceux liés à la production plus propre (table 2) ou à la prévention ou réduction à la source de la pollution.

Leader en coûts : un produit ou un service aux caractéristiques semblables à celles de la plupart des concurrents, mais à un coût inférieur

Le Diagnostic Environnemental des Opportunités de Minimisation (DEOM) apparaît comme l'un des instruments les plus intéressants pour ces entreprises (mais également pour celles appliquant la stratégie de la différenciation) ; en effet, le DEOM cherche lui aussi à mettre en place la réduction des coûts de la gestion de l'environnement tout en obtenant des bénéfices environnementaux.

Table 2 : La production plus propre

Application continue d'une stratégie intégrée de prévention de l'environnement dans les procédés, les produits et les services dans le but d'accroître l'efficacité globale et de réduire les risques pour les êtres humains et l'environnement. En ce qui concerne les procédés, la production plus propre inclut la conservation des matières premières, de l'eau et de l'énergie, l'élimination des matières premières toxiques et la réduction de la quantité et de la toxicité de tous les rejets dans l'eau et l'atmosphère, et des déchets. En ce qui concerne les produits, la stratégie a pour objet la réduction de tous les impacts pendant le cycle de vie du produit, depuis l'extraction des matières premières jusqu'au déchet final. En ce qui concerne les services, cela suppose l'inclusion d'aspects environnementaux dans la conception et la distribution des services. La production plus propre s'obtient moyennant l'application des connaissances, l'amélioration de la technologie et le changement d'attitude. (Programme des Nations unies pour l'environnement)

4 Kit Sadgrove. *La ecología aplicada a la empresa*. Ediciones Deusto. Bilbao. (1993).

LE DIAGNOSTIC ENVIRONNEMENTAL DES OPPORTUNITÉS DE MINIMISATION (DEOM)

Le DEOM, méthodologie à la disposition des entreprises, facilite la prise de décisions et la planification visant à prévenir la pollution à la source.

Il s'agit d'une évaluation d'une activité industrielle menée par un expert en vue de déceler les éventuelles opportunités de prévention et de réduction à la source de la pollution liée aux processus de production, aux courants résiduaires ou aux activités globales de l'entreprise.

Quelques avantages de la réalisation d'un DEOM sont par exemple la réduction des coûts (gestion de l'environnement, consommation de ressources et de matières, etc.), l'amélioration de la situation environnementale, l'introduction de l'éco-efficacité dans les procédés industriels, etc.

Comme nous l'avons vu auparavant, l'objectif des entreprises appliquant la stratégie de leadership en coûts correspond à l'un des avantages précité du DEOM. Dans ce cas, l'utilisation de la méthodologie du DEOM permet aux entreprises d'intégrer directement la variable environnementale dans la gestion stratégique globale.

Le DEOM permet aux entreprises d'intégrer directement la variable environnementale dans la gestion stratégique globale

L'EXPÉRIENCE DE LA CATALOGNE

Jusqu'à présent, plus de 350 entreprises catalanes ont réalisé un DEOM sous la supervision du *Centre per a l'Empresa i el Medi Ambient* (CEMA). Une étude réalisée auprès des 213 entreprises ayant effectué un DEOM entre 1996 et 2000 a analysé l'introduction des propositions détectées lors du DEOM ainsi que les bénéfices environnementaux et les résultats économiques obtenus. La réponse a été de 125 entreprises.

La distribution par secteurs d'activité est résumée dans la figure 1. On constate que les secteurs les plus représentatifs de la Catalogne y sont présents. Il est remarquable de voir que plus de 50 % des alternatives introduites (figure 2), classées selon 4 typologies générales, correspondent à des alternatives considérées comme des Bonnes pratiques environnementales. Il s'agit d'alternatives présentant un coût nul ou très bas,

En ce qui concerne l'impact environnemental de la réalisation des DEOM, les résultats sont très significatifs

Figure 1 : Secteurs d'activité ayant participé à l'étude par numéro d'entreprises

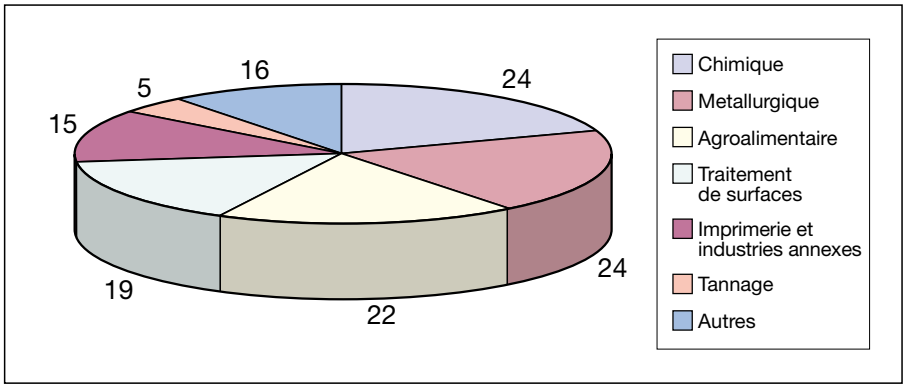


Figure 2 : Typologie des alternatives introduites

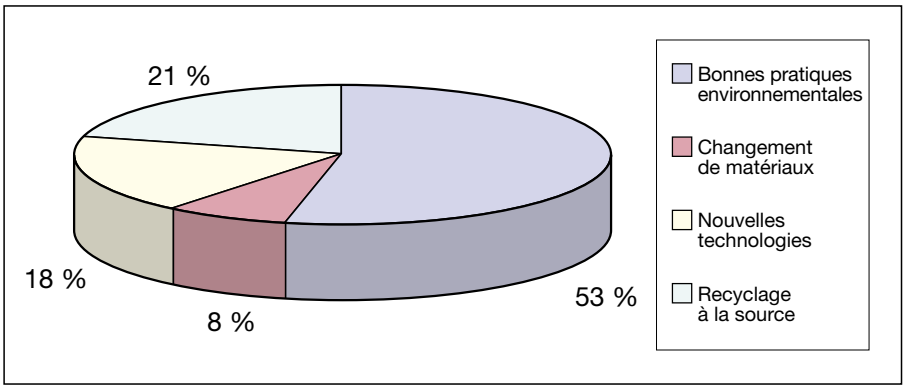


Table 3 : Bénéfices environnementaux de l'introduction des alternatives recommandées

Réduction de la génération de déchets	57,6 %
Réduction de la génération d'émissions dans l'atmosphère	49,0 %
Réduction de la génération d'eaux résiduaires	63,3 %
Réduction de la consommation d'eau	58,7 %
Réduction de la consommation de matières premières	40,7 %

mais qui permettent généralement aux entreprises d'obtenir des bénéfices économiques presque immédiats.

En ce qui concerne la réduction de l'impact environnemental de l'introduction des alternatives suggérées lors de la réalisation des DEOM, les résultats sont très significatifs (table 3). Il faut dire cependant que les résultats liés à la réduction correspondent uniquement au procédé pour lequel l'alternative a été introduite et non à l'activité dans son ensemble.

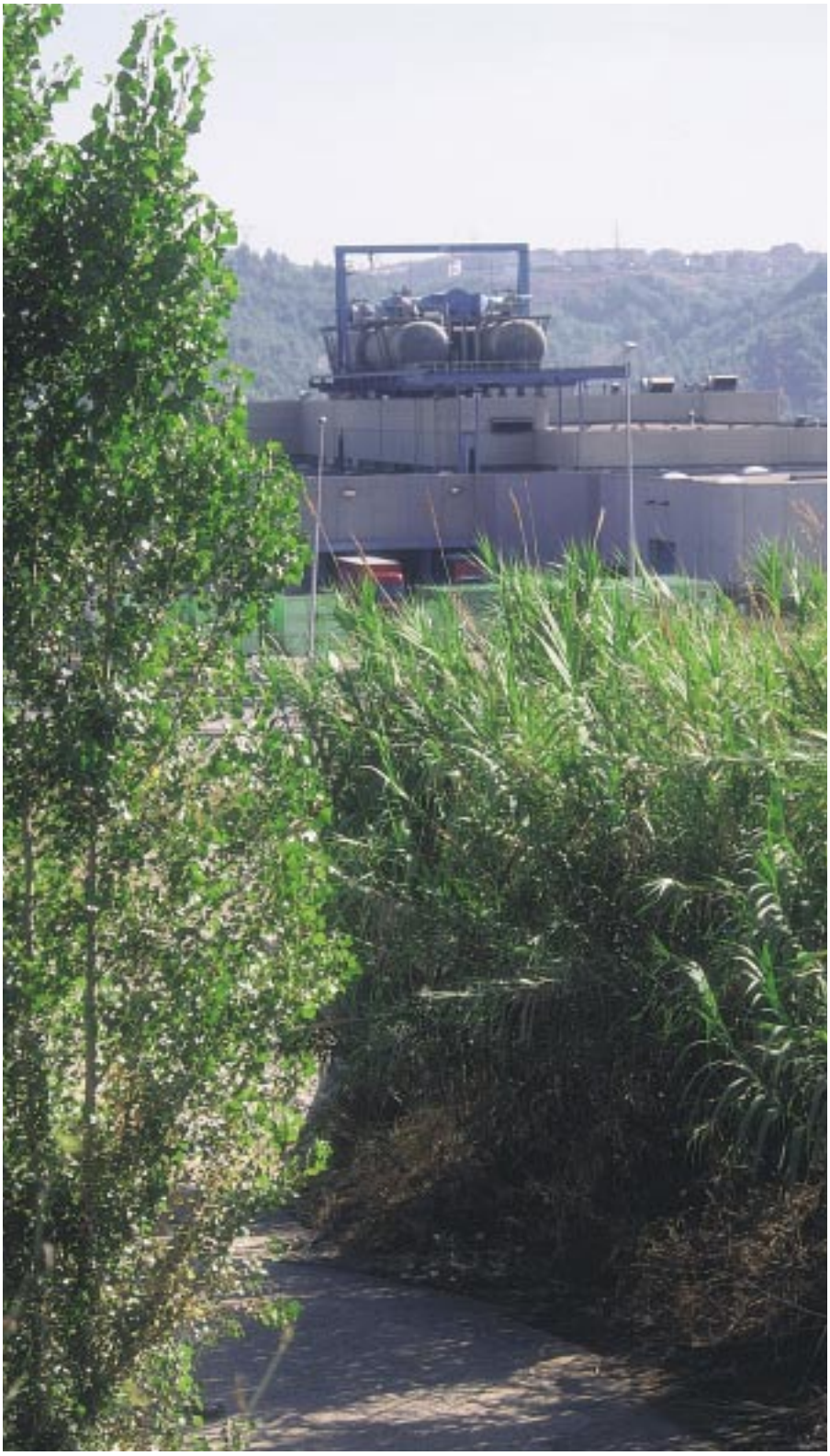
De toutes façons, l'aspect possiblement plus important est l'impact économique de l'introduction des alternatives proposées. En effet, l'investissement total a été d'environ 8,8 millions €, ce qui a produit une économie d'environ 3,6 millions €/an ; ceci signifie que la période d'amortissement de l'investissement (PAI) a été d'environ 2,4 ans, tout en considérant les bénéfices environnementaux associés.

Encore une fois, et toujours selon l'étude réalisée, ceci signifie pour les entreprises la possibilité de réaliser de véritables économies tout en introduisant des changements dans leurs procédés (de fabrication ou auxiliaires) visant la prévention ou la réduction de la pollution à la source.

Conclusions

Dans leur recherche d'un avantage compétitif, les entreprises doivent décider d'une stratégie qui définit leur façon d'agir conformément aux valeurs et à la mission (et à la vision) de l'entreprise pour atteindre les objectifs souhaités. La manière dont l'entreprise intègre la gestion de l'environnement doit donc être incorporée à cette stratégie globale. En conséquence, chaque entreprise doit trouver les instruments les mieux adaptés à cette intégration.

Pour les entreprises qui basent leur stratégie sur la réduction des coûts, le DEOM s'avère un instrument très puissant permettant la réduction de la consommation de matières premières et de ressources ainsi que la réduction des courants résiduaires générés par l'entreprise, tout en obtenant des bénéfices économiques et souvent d'autres bénéfices non tangibles, par exemple l'amélioration du niveau technique des travailleurs, une réduction des risques divers et une meilleure image de l'entreprise.



MOED: A TOOL AT THE SERVICE OF ENTERPRISE CORPORATE STRATEGY

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Environmental issues already play a significant role when developing a company's corporate strategy. Whether a business decides to choose a management strategy of cost leadership, or whether they choose to emphasise differentiation, the way of approaching environmental issues should by all means form an essential part of their overall strategy by employing the tools most appropriate to their circumstances. In both cases, but more notably in the case of those who choose to emphasise profit, the Minimisation Opportunities Environmental Diagnosis (MOED) could prove a powerful instrument when attempting to identify potential sources of revenue.

Key words: Cost leadership, differentiation, competitive advantage, generic strategy, eco-innovation, environmental management system, MOED, eco-efficiency, Good Housekeeping Practices.

DAOM: UN INSTRUMENTO AL SERVICIO DE LA ESTRATEGIA CORPORATIVA DE LA EMPRESA

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Los aspectos ambientales constituyen un factor importante que debe contemplarse a la hora de concebir la estrategia corporativa de cualquier empresa. La empresa puede elegir entre adoptar una estrategia de liderazgo en costes o bien una estrategia de diferenciación. Sin embargo, ineludiblemente, el modo de abordar la gestión ambiental a través del empleo de instrumentos adaptados a cada situación debe formar parte de la estrategia global. En ambos casos, pero especialmente para quienes desean convertirse en líderes en costes, el Diagnóstico Ambiental de Oportunidades de Minimización (DAOM) ofrece una herramienta de suma utilidad en particular, ya que permite identificar las fuentes potenciales de ahorros económicos.

Palabras clave: Liderazgo en costes, diferenciación, ventaja competitiva, estrategia genérica, ecoinnovación, sistema de gestión ambiental, DAOM, ecoeficiencia, buenas prácticas ambientales.

COMPOST POTENTIAL OF CHICKEN MANURE: A CASE STUDY FROM CORUM

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The existing and potential animal breeding capacity of Turkey, as well as the related solid waste generation and environment-friendly disposal methodologies were investigated. Specific neighbourhoods, from amongst the most problematical areas due to their large animal population, were chosen as the pilot areas for the implementation of feasibility studies. The amount and the characterization of solid waste were determined for the selected pilot area by means of data collection, sampling and an analysis program. Feasibility studies consisting of technical implementation criteria and operational conditions of the animal waste composting systems were carried out for the pilot area, the city of Corum.

Key words: Animal waste, characterization, standards, composting, feasibility.

Introduction

Animal waste is used as either fertilizers or a fuel source (after being dried). Animal waste-related environmental problems have increased over the last few decades in which remarkable changes have taken place regarding farm size and animal waste production. Water pollution problems caused by animal waste are generated by drainage from confined areas and land used for disposal.

On the other hand, energy crises brought a new dimension to the animal waste disposal problem; people have tried to benefit from animal waste as alternative sources of energy, whilst still maintaining its value as a fertilizer. Livestock manure (defined as a mixture of faeces and urine) has been recognized as beneficial to crop growth and soil fertility (chemical and structural) for millennia (Tanner, R.J. et al., 2001).

Due to the increase both in the number and capacity of integrated cattle and poultry farms, there is a strong need for the implementation of technologies which are feasible from an ecological and an economical point of view. Pilot areas were defined, taking into account environmental health, the concept of renewable energy, and compost/soil improvement issues. One of the selected pilot areas, Corum, was used to carry out a feasibility study of a disposal technique.

CHICKEN MANURE PRODUCTION IN THE CORUM AREA

Animal type, its weight, feeding system, and seasonal changes all directly affect the character of manure (Topkaya, B., 2001).

In order to choose the pilot areas for the feasibility studies, the overall cattle, sheep and poultry production distribution was investigated. City/town-based research showed that in 1999, there were 30 million sheep, 11 million cattle and 246 million poultry in Turkey. As most of the farms/poultry farms are located in specific areas, three cities representing these areas were selected within the framework of this study. General information is hereby presented regarding the selected cities:

- Kayseri, located in the Anatolian region of Turkey specializes in poultry for meat production.
- Corum, located close to the centre of the Black Sea region, has a chicken breeding capacity of 3 million, which has generated a serious chicken manure problem.
- Balikesir/Manyas located near the Aegean Coast is also very close to one of the most renowned areas of ecological sensitivity in Turkey.

Corum, with the highest chicken manure generation figures in Turkey was selected to be observed for manure management within the framework of this study.

Corum has the highest chicken manure generation figures in Turkey

The main environmental problem in the area in question was the lack of chicken manure management. The major current disposal system for chicken manure was to use it as a fertilizer. Dumping of the waste was also carried out to such an extent as to cause serious water pollution. The number of chickens on 136 poultry farms in the region was around 2,000,000 for July 2001 (Government Statistics of Turkey, 2001). The total chicken manure production which was roughly 350-400 t/d (175 g/chicken) had a moisture content of between 8 and 75%. The reasons behind low manure production is that less manure is produced by chickens destined to be eaten than those reared for their eggs.

On the other hand, only 65% (88 of 136) of the poultry farms are working efficiently (70% were normal (1-floor), 20% had a 2-floor system and 10% use a conveyor belt). As can be seen in Table 1, the moisture content of manure is very low for the 2-floor system in comparison with the 1-floor system.

Table 1. Characteristics of the chicken manure generated in the Corum area

Parameter	Sample	Moisture (%)	Ash (%)	Fly ash (%)	Fixed C (%)	Total S (%)	C (%)	H (%)	N (%)	P (g/kg)	Calorific value (kJ/kg)
1-floor poultry	Original	74.38	8.0	15.61	2.01	0.08	-	-	-	-	-
	Dry	-	31.21	60.93	7.86	0.32	36.25	4.71	3.56	16.7	14,108
2-floor poultry	Original	8.11	53.14	36.18	2.57	0.29	-	-	-	-	-
	Dry	-	57.83	39.37	2.8	0.32	32.45	4.36	3.72	21.9	10,543

EVALUATION OF THE CHARACTERISTICS OF THE CHICKEN MANURE

For the optimum management of poultry farms in the selected region the following issues were taken into account:

- Number of chickens per poultry farm
- Chicken breeding methods
- Manure production by the chicken
- Determination of the disposal methods for the chicken manure produced.

A summary of the analyses made for chicken manure produced in the selected region are summarized in Table 2. In this region, all of the poultry farms are constructed for egg production.

In Corum, the characteristics of the chicken manure generated showed variations according to the purposes of the breeding (chicken for meat or for eggs), and manure generation conditions. In 2-floor poultry farms where paddy, straw and sawdust are used for "chicken for meat", the moisture content of the manure is 75%. This is roughly equal to that shown by 1-floor poultry farms of "chickens for eggs" (Baban, A., et al., 2001), whereas for the poultry farms with 2-floors, it is lower (Table 2).

Chicken manure is richer than cattle manure, which will impact positively on the compost quality

For the composite sample of the Corum region, which was calculated based on assumptions for 2020, it has been shown that the manure has a characteristic of 38.8% dry matter content and 9.9.% C/N ratio (Table 3). The amount of manure is expected to increase to 400 t/d for 3 million chickens in 2020. 80% of the total poultry farms will have 2-floors and the rest will have 1-floor.

Table 2. Chicken manure characteristics for the selected area (2001)

Manure/ parameter	Dry Matter %	*Fly Ash %	*Fixed Carbon %	*Carbon/ Nitrogen (C/N)	*Calorific Value, kJ/kg	*Manure Amount t/d
Chicken for egg production						
1 floor poultry	25.6	60.9	7.9	10.2	14,108	240 (total)
2 floor poultry	91.9	39.4	2.8	8.7	10,543	

*results of analyses on dry basis

Table 3. Characteristics of chicken manure for the Corum Region for the year 2002

Manure/ parameter	Dry Matter %	*Fly Ash %	*Fixed Carbon %	*P g/kg	*Total Carbon %	Carbon/ Nitrogen (C/N)	Calorific Value, kJ/kg	*Manure Amount t/d
Chicken for egg production								
1 floor poultry	25.6	60.9	7.9	16.7	36.2	10.2	14,108	320
2 floor poultry	91.9	39.4	2.8	21.9	32.4	8.7	10,543	80
Σ composite	38.8	56.6	6.9	17.7	35.4	9.9	13,395	400

*results of analyses on dry basis

As the optimum conditions for composting are reported to be 50-60% moisture, the manure should be desiccated (Georgakakis, D et al., 2000 and Guerra-Rodríguez, E. et al, 2000).

The nitrogen content of the chicken manure decreases from 4.5 to 2.4% if straw, sawdust and paddy are used in the poultry farms. The C/N ratio for the three selected regions show variations between 9 and 10 for both cattle farms and poultry farms. However, the ideal C/N ratio for composting is reported to be 30:1 (Topkaya, B., 2001). Lower C/N ratios will leave the system by leading to odour pollution. Composting or anaerobic digestion would be an optimum disposal process for chicken manure in Corum only if an appropriate C/N ratio can be supplied from outside. As there exists an area of 700 hectares is about 5 km away from the poultry farms, which can be used for the disposal of manure, composting could provide the best solution for manure management. In addition to this, regarding nutrient content, chicken manure is richer than cattle manure, which will impact positively on the compost quality. The environmental and technical feasibility study for the selected region, Corum was carried out taking this into account.

COMPOST PROCESS DESIGN

Organic waste (sawdust and leaf litter) of 250 t/d with a dry matter content of 90% and C/N ratio of 65 was added to improve the compost quality. Moreover, the addition of another type of waste would bring the advantage of increasing both the porosity of the manure and penetration of air through the compost.

As an initial step for composting, the chicken manure was adapted to the values of 30 for C/N ratio and 50% for solid matter content.

The compost plant criteria and assumptions are given in Table 4. Material balance for the compost process is illustrated in Figure 1. The compost characteristics and process assumptions are also integrated (Georgakakis, D et al., 2000 and Guerra-Rodríguez, E. et al, 2000).

Table 4. Process design criteria for compost plant in Corum

Parameter	assumption/criteria
Minimum temperature requirement for composting	55 °C
Minimum retention time of manure while composting	3 days (Topkaya, 2001)
Maturation period of compost	21 days
Type of compost reactor	rotating drum reactor
Dry matter reduction by fermentation	1-1.5/d % (by weight)
Water vaporization due to fermentation	(reduced DM)x4500kcal/900kcal
Water vaporization as a result of retention	2.5 kg/m²-day
Volume increment due to porosity character of material after composting	50%

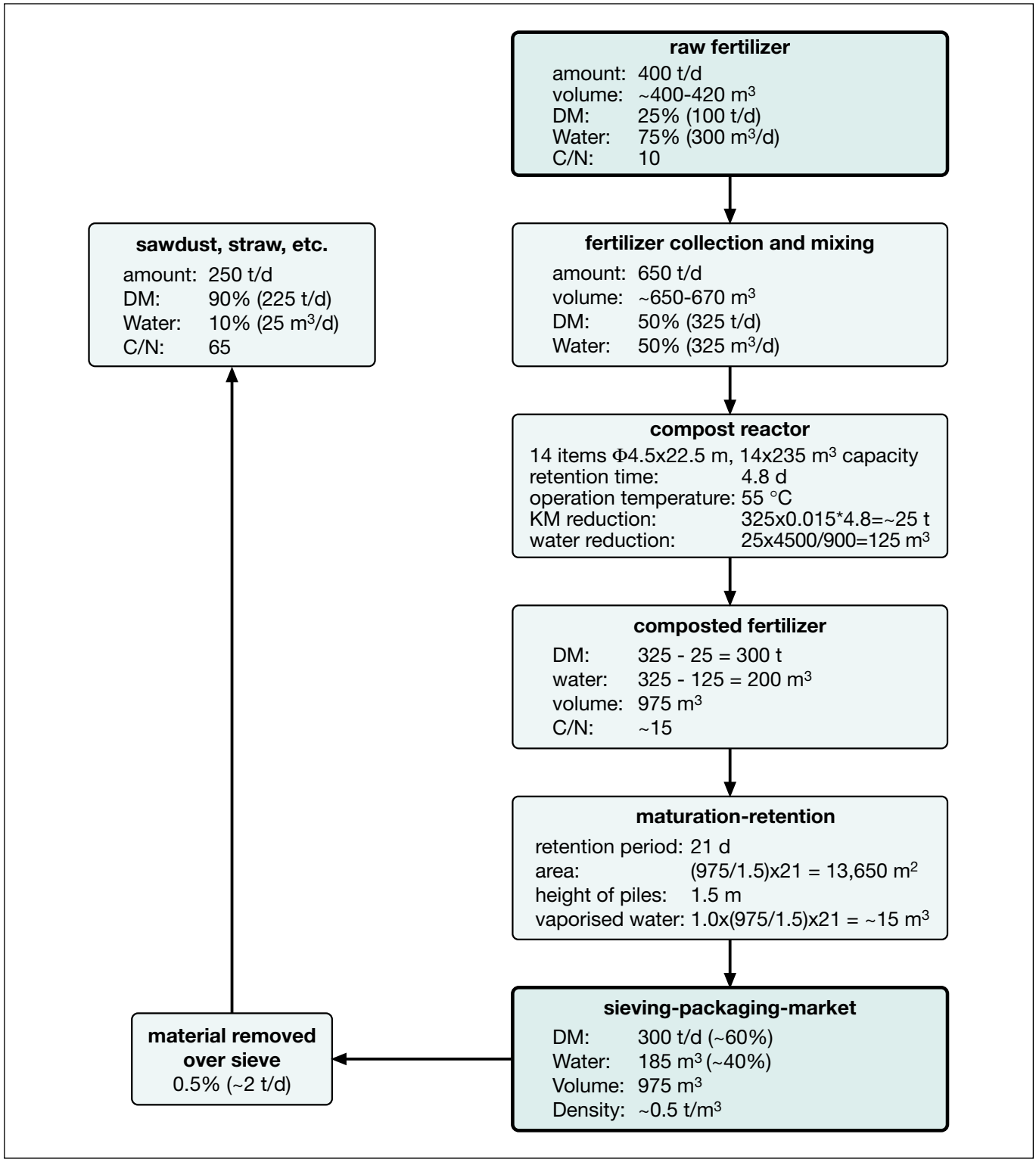

Figure 1. Material Balance for the Composting Plant in Corum

Conclusions

This study has been carried out for the feasibility study of manure management techniques in Turkey. As cattle and poultry farms are located intensively in three cities and in the surrounding regions, these areas were selected for the implementation of the feasibility techniques for each area, depending on the type of animal, conditions of the stable/poultry farm and characteristics of the manure. Within this framework depending on the poultry farm potential, detailed information on sources of chicken manure and its collection system were evaluated for Corum, the selected area. Beyond this framework, composting as an optimum disposal technique was investigated with special emphasis on the chicken breeding systems (1-floor or 2-floor) and manure characteristics.

Composting, with its comparatively simple operative conditions, minimal equipment requirement and limited operational information, was determined to be one of the feasible options. The technical and environmental issues indicated that a composting plant for Corum –particularly a centralized one with more hygienic conditions and higher quality product than that produced by individual composting- is worth implementing.

Acknowledgement

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POTENTIEL DU COMPOSTAGE DE FUMIER DE POULET : CAS PRATIQUE DE LA VILLE DE CORUM

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La capacité actuelle et potentielle de la Turquie dans le domaine de l'élevage, la génération des déchets solides correspondants ainsi que les méthodologies d'élimination des déchets respectueuses de l'environnement sont les objets de cette étude. Quelques municipalités turques comptant parmi les zones les plus problématiques en raison d'une vaste population animale et d'une haute sensibilité ont été choisies comme zones pilotes pour l'introduction d'études de faisabilité. La quantité et la caractérisation des déchets solides ont été déterminées pour la zone pilote susdite par un programme de collecte de données, de prélèvements et d'analyse. Des études de faisabilité présentant des critères techniques d'introduction et des évaluations des conditions d'exploitation des systèmes de compostage des déchets animaux ont été réalisées pour la zone pilote, notamment à Corum.

Mots-clé : Déchets animaux, caractérisation, standards, compostage, faisabilité.

POTENCIAL DEL COMPOST ELABORADO CON GALLINAZA: EL CASO DE CORUM

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En el presente documento se estudia la capacidad de cría de ganado potencial y real de Turquía, así como la generación de residuos sólidos resultante y las metodologías respetuosas con el medio ambiente de eliminación de desechos aplicables. Entre las regiones más problemáticas por lo que concierne a su inmensa población animal y sensibilidad, se escogieron varias zonas en las que se realizaron estudios piloto de viabilidad. La cantidad y las características de los desechos sólidos de las zonas piloto seleccionadas se determinaron en función de las muestras y los datos recopilados y de un programa de análisis. Se elaboraron estudios de viabilidad específicos para la zona piloto aplicando criterios de implementación técnica y contemplando las condiciones operativas de los sistemas para el compostaje de los residuos animales; el estudio se llevó a cabo en Corum.

Palabras clave: Residuos animales, caracterización, estándares, compostaje, viabilidad.

CLEANER PRODUCTION PRACTICES AND TECHNIQUES IN THE DAIRY INDUSTRY

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The production processes developed by the dairy industry are associated with high levels of water and energy consumption and with emissions of residual liquid streams with a significant organic load. The implementation of cleaner production practices reduces the costs of both the consumption of resources and the end-of-pipe treatment of the residual streams generated.
This article describes in detail some of the ways of avoiding pollution that have been successfully implemented in the dairy industry, such as:

1. Whey recovery and reuse
2. Optimisation of CIP cleaning systems
3. Optimisation of installation and surface cleaning operations
4. Recovery of product retained in pipelines
5. Optimisation of hot water production for processing
6. Optimisation of heat recovery percentages in heat treatments for pasteurisation and UHT sterilisation

Key words: Cleaner Production, dairy industry, cheese whey, water-consumption, energy-consumption, CIP.

PRACTICAL APPROACH TO CLEANER PRODUCTION ASSESSMENT

Cleaner Production is defined as "the continuous application of an integrated preventive environmental strategy applied to processes, products and services, to increase overall efficiency and reduce risks to humans and the environment." (UNEP).

Cleaner Production can be, and has already been, successfully applied to different production processes or industrial activities.

Technological improvements can occur in a number of ways (see Table 2):

I. changing manufacturing processes and technology
II. changing the nature of process inputs (ingredients, energy sources, recycled water, etc.)
III. changing the final product or developing alternative products
IV. on-site reuse of waste and by-products

It is nevertheless true that Cleaner Production is about attitudinal as well as technological change. In many cases, the most significant Cleaner Production benefits can be gained through lateral thinking, without adopting new technological solutions.

Investing in Cleaner Production, to prevent pollution and reduce resources consumption, is more cost effective than continuing to rely on increasingly expensive "end-of-pipe" solutions. Cleaner Production options will generate savings through reduced costs for raw materials, energy, waste treatment and regulatory compliance. Furthermore, the environmental benefits of Cleaner Production can be translated into marketing opportunities for "greener" products. Companies that factor environmental considerations into the design stage of a product will be well placed to benefit from the marketing advantages of any future eco-labelling schemes.

Table 1. Applying Cleaner Production Options (CPOs)

Industry/production area	Cleaner Production approaches
Production processes	Conservation of raw materials and energy Elimination of toxic raw materials Reduction in the quantities and toxicity of waste and emissions
Product development and design	Reduction of negative impacts throughout the life-cycle of the product
Service industries	Incorporation of environmental considerations into the design and delivery of services

Table 2. Evaluation of Cleaner Production Options

CP option	Benefits
Good housekeeping	Improvements to work practices and proper maintenance can produce significant benefits. These options are typically low cost.
Process optimisation	Consumption of resources can be reduced by optimising existing processes. These options are typically low to medium cost.
Raw material substitution	Environmental problems can be avoided by replacing hazardous materials with more environmentally benign materials. These options may require changes to process equipment.
New technology	Adopting new technologies can reduce resource consumption, and minimise waste generation through improved operating efficiencies. These options are often highly capital-intensive, but payback periods can be quite short.
New product design	Changing product design can result in benefits throughout the life-cycle of the product, including reduced use of hazardous substances, reduced waste disposal, reduced energy consumption and more efficient production processes. New product design is a long-term strategy and may require new production equipment and marketing efforts, but paybacks can ultimately be very rewarding.

CLEANER PRODUCTION OPPORTUNITIES IN THE DAIRY INDUSTRY

Dairy processing typically consumes large quantities of water and energy, and discharges significant loads of organic matter in effluent streams. For this reason, Cleaner Production opportunities described in this paper are focussed on reducing the consumption of resources (water and energy), increasing production yields, and reducing the volume and organic load of effluent discharged.

As a result, many Cleaner Production opportunities lie in the selection, design and efficient operation of process equipment. Operator practices also have an impact on plant performance, for example, in the areas of milk delivery, plant maintenance and cleaning operations.

The next section describes some Cleaner Production opportunities that apply across the entire process, and some others that relate specifically to individual unit operations within the process. These are divided into four key areas (see Figure 1).

All Cleaner Production opportunities described in these sections have been successfully applied in dairy processing plants.

Good housekeeping practices in the dairy industry include:

- Reduction of product losses by better production control.
- Collection of waste product for use in lower-grade products such as animal feed where this is feasible without exceeding cattle feed quality limits.
- Optimisation of use of water and cleaning chemicals; recirculation of cooling waters.
- Segregation of effluents from sanitary installations, processing, and cooling (including condensation) systems; this facilitates recycling of waste water.
- Use of condensates instead of fresh water for cleaning.
- Recovery of energy by using heat exchangers for cooling and condensing.
- Employment of high-pressure nozzles to minimise water usage.
- Avoidance of the use of phosphorus-based cleaning agents.

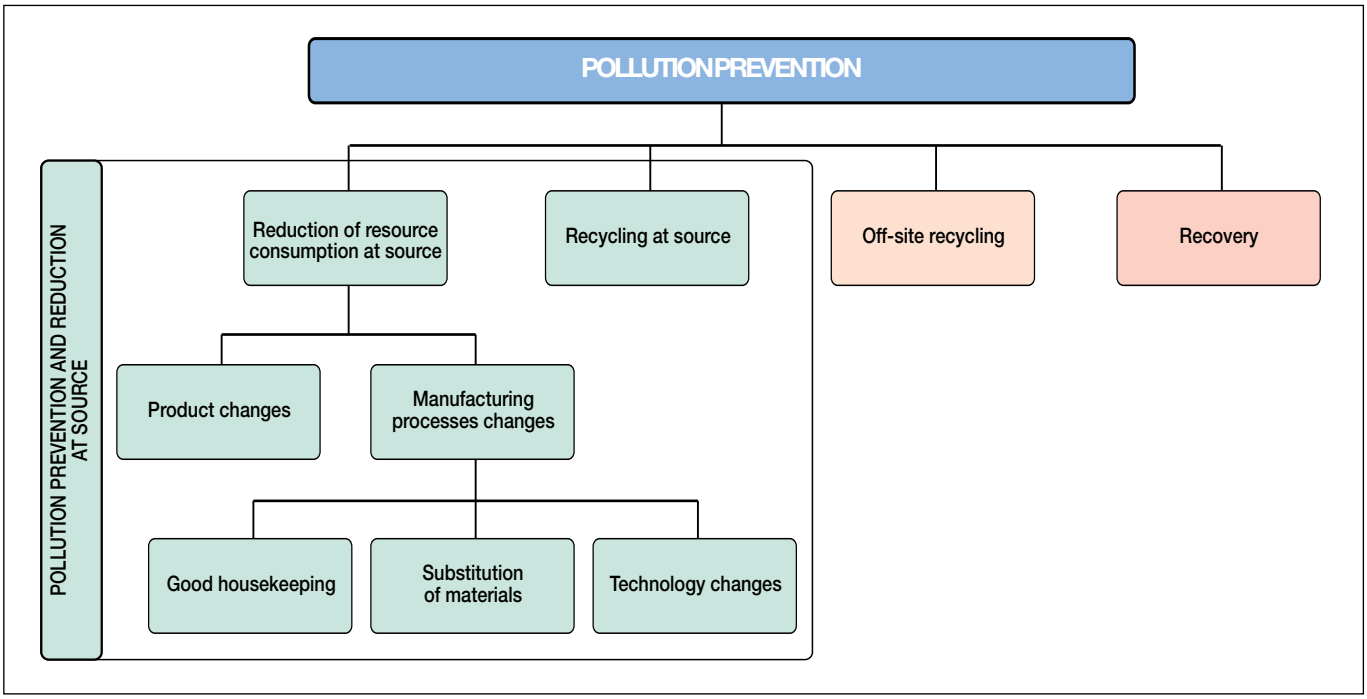


Figure 1. Classification of Dairy Cleaner Production options

CPO-1. RECOVERY AND INCREASE IN VALUE OF CHEESE WHEY

1) Type of Cleaner Production Option

On-site recycling.

2) Environmental issue

The major environmental issue associated with the cheese-making process is the disposal of whey. There are generally three types of whey:

I. rennet or sweet whey: generated when enzymes, principally rennet, are used to coagulate the milk. Sweet whey typically contains 0.6-0.9% soluble protein, up to 0.3% fat and large quantities of lactose (up to 5%). The pH value of sweet whey is generally 5.1-5.3.

II. acid whey: generated when acid or a starter culture is used to coagulate the milk. Acid whey typically contains the same proportion of soluble proteins as sweet whey, but less fat and somewhat less lactose (4.5%), since some of the lactose is converted to lactic acid. It has a low pH value, between 4.5 and 4.7.

III. salt whey: product expressed during the pressing of salted cheese curd. This whey should be collected separately from other types of whey.

The major environmental issue associated with the cheese-making process is the disposal of whey

Table 3. Whey composition

	Rennet whey	Acid whey
Water, %	93 – 94	94 – 95
Density, kg/l (at 15°C)	1.026	1.025
Fat, %	up to 0.8	traces
Protein, %	up to 0.9	up to 0.9
Lactose, %	4.5 – 5	3.8 – 4.4
Lactic acid, %	traces	up to 0.8
Mineral (ash), %	0.5 – 0. 7	0.7 – 0.8
pH value	6.2 – 6.6	4.5 – 4.7

In addition, whey produced from cheese-making plants contains approximately 6% solids and a high organic load, COD effluent concentration is about 60,000 mg O_2/l. The discharge of effluents with this high concentration of organic matter can lead to pollution of rivers and streams, and can create unpleasant odours.

3) Cleaner Production Opportunities

A number of opportunities exist for the recovery of the valuable high-grade protein from sweet whey. However it is only in recent years that they have become technically and economically viable. The common method used is membrane separation. This process is costly, so only worthwhile when large quantities of fresh whey are available (for volumetric flow rates up to 70,000 l/week). If the generated whey in a cheese-making plants is lower than 70,000 l/week, heat-precipitation may be a better option.

Options available for whey utilisation are shown in the following Figures.

Treatment descriptions

Primary treatment

Necessary in both options.
The treatment consists in screening all liquid streams (whey that is expelled from the curd mass) to collect fines.
Fines concentration can reach approximately 6-7 g/l. The amount of fines depends on the curd mass cutting process. Recovered solids (fines) could then be reused in the melted cheese-making process.
The next step consists of a fat centrifugal separation to avoid membrane damage during the subsequent processes.

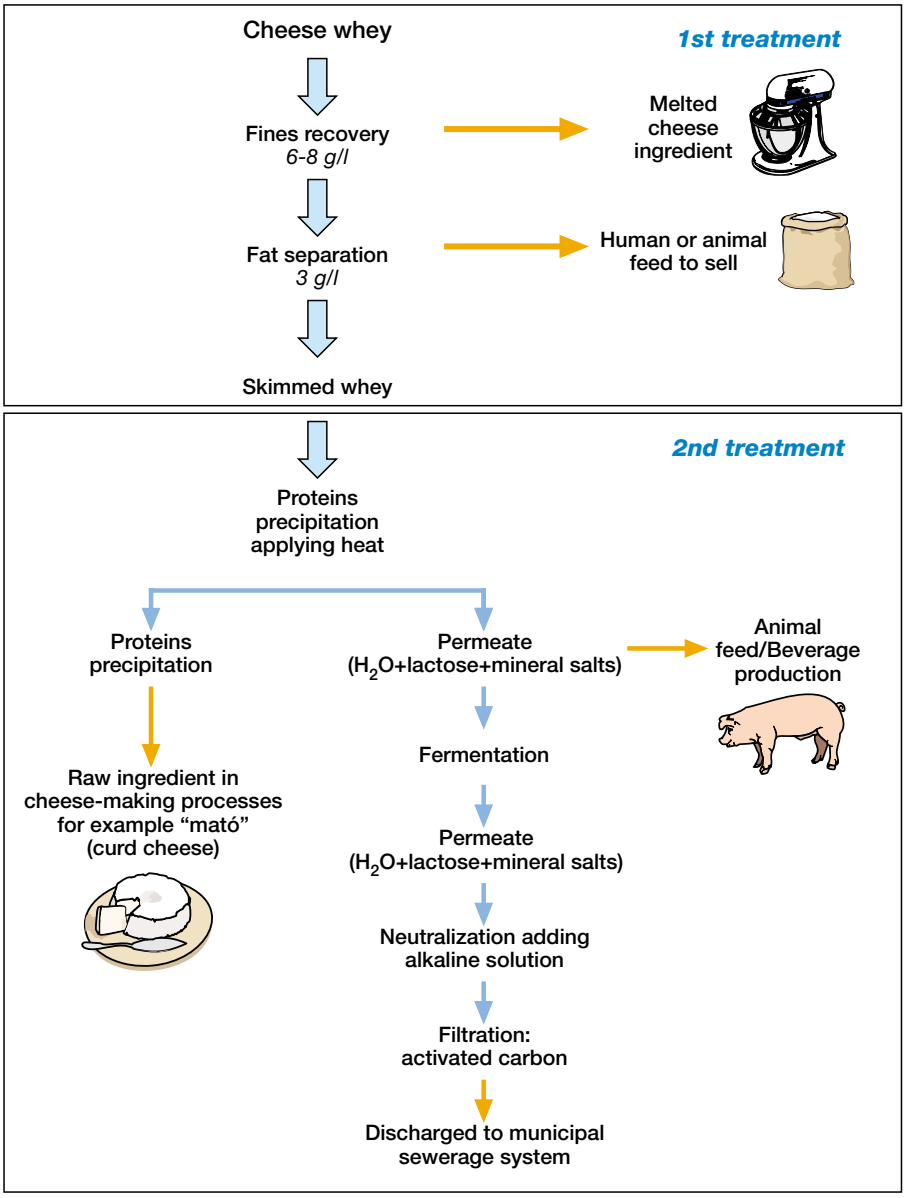


Figure 2. Whey recovery process: low volume

Secondary treatment

a) *Cheese-making plants that produce small quantities of fresh whey*

This treatment consists of heat-acid precipitation of whey proteins. Solution acidification is necessary to adjust the pH of the whey to about 4.5 (the iso-electric point) which is the most favourable pH value for precipitation. Rennet whey is generally acidified with lactic acid (addition of up to 0.5 l of 80% lactic acid per 1000 l of whey). If the whey is acidic enough, no further acid need be added. It is even sometimes necessary to raise the pH, as in the case of acid whey which may leave the cheese-making plant with a pH of 4.

The whey protein concentrate (WPC) obtained can then be added to the milk destined for some soft cheese-making plants, as in the curd cheese manufacturing processes.

The permeate solution (lactose, water and mineral salts) could then be used as animal feed or for the production of dairy products. If it is not possible to reuse the permeate, it cannot be discharged directly into the effluent. It is therefore necessary to process the permeate even though this is uneconomic. To reduce the organic load of effluent, a lactose-fermentation process may be of interest.

b) *Cheese-making plants that produce large quantities of fresh whey*

The method used is ultra filtration (UF), followed by spray-drying of the protein. Reverse Osmosis is the best option in batch processes or when whey flow rate is below 5,000 l/h. Spray-dried whey powder contains between 25% and 80% protein, and is used in food products where it performs a similar function to egg proteins. Whey powder is highly soluble, even at high acidity, and

is capable of forming stable foams and gels when heated. Whey protein powder is therefore used in manufacturing of bakery and meat products, where its gelatinous properties are particularly useful.

In addition, there are a number of CPOs for reducing the loss of product from the process, which include:

- Preventing the loss of curds by not overfilling cheese vats
- Completely removing whey and curds from the vats before rinsing
- Segregating all whey drained from the cheese
- Sweeping up pressings, instead of washing them to drain
- Screening all liquid streams to collect fines

4) Economic and environmental evaluation

- ☺ Cost savings from wastewater load reduction
- ☺ Additional revenue from the sale of by-products
- ☺ Reduction of organic load and conductivity effluent discharged
- ☺ Reduction of liquid effluent volume discharged
- ☺ Increase in value of waste flow
- ☹ Staff training cost
- ☹ Capital cost to invest in new technology

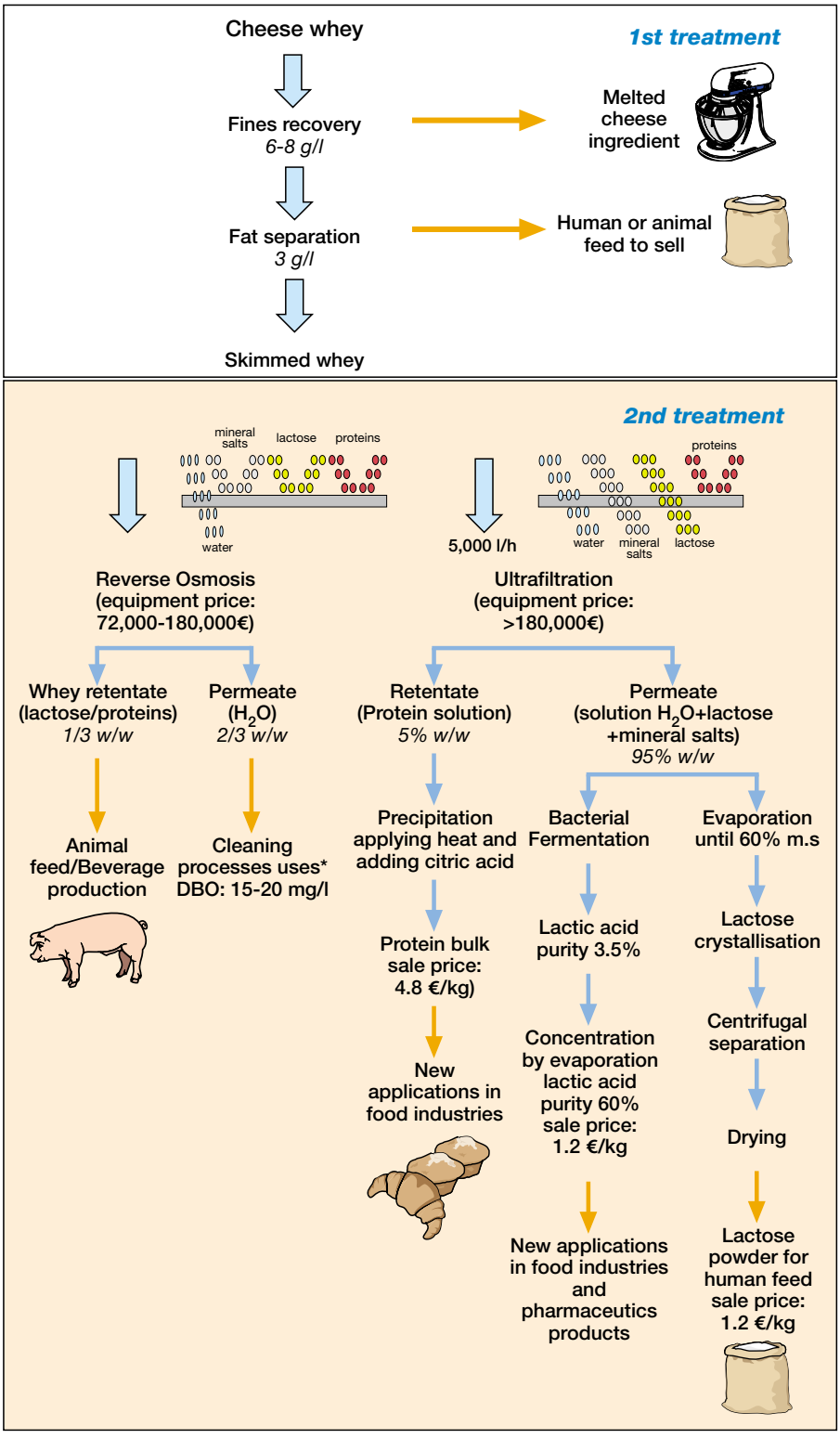


Figure 3. Whey recovery process: high volume

CPO2. IMPROVED OPERATION PROCEDURE IN CLEANING PROCESSES

1) Type of Cleaner Production Option

On-site reduction of resource consumption. Good housekeeping.

2) Environmental issue

Cleaning consumes large quantities of water in the dairy industry.

The pollutant load of cleaning wastewater is considerable, due to the presence of milk fat and proteins as well as detergents and disinfectants.

3) Cleaner Production opportunities

The implementation of the optimum cleaning systems in a dairy industry depends on:
- the scale of the plant
- the age and type of processing
- whether batch or continuous processes are used
- the operator's practices

Strategies for reducing water consumption can involve technological solutions or equipment upgrade. However, substantial benefits can also be gained from examining cleaning procedures and operators' practices.

The use of new cleaning techniques would represent best practice for industry. By doing so, water consumption can be reduced to as little as 0.8-1.0 l/kg milk intake.

The most important opportunity to reduce water consumption is the implementation of a low-pressure and/or high-pressure cleaning system.

The most important characteristics of these cleaning-systems are described in Table 4.

Strategies for reducing water consumption can involve technological solutions or equipment upgrade

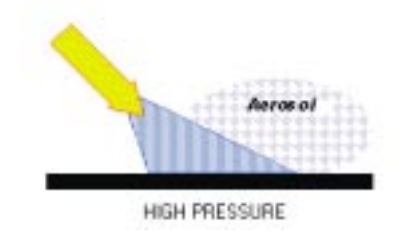
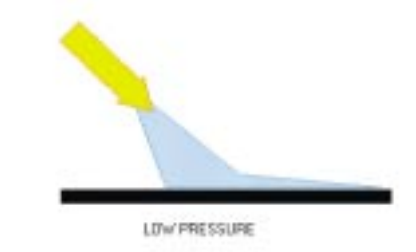
In addition, other key strategies for reducing water consumption are listed below:

I. use of continuous rather than batch processes to reduce the frequency of cleaning
II. implementation of automated cleaning-in-place (CIP) systems for cleaning control and optimisation of water use
III. installing fixtures that restrict or control the flow of water for manual cleaning processes
IV. using high pressure rather than high volume for cleaning surfaces
V. reusing relatively clean waste waters (such as those from final rinses) for other cleaning steps or in non-critical applications
VI. recirculating water used in non-critical applications
VII. installing meters on high-use equipment to monitor consumption
VIII. pre-soaking floors and equipment to loosen dirt before the final clean
IX. using compressed air instead of water where appropriate
X. reporting and fixing leaks promptly

4) Economics and environmental evaluation

- ☺ Cost savings from reducing the water consumption
- ☺ Cost savings from minimising cleaning agent consumption
- ☺ Cost savings from reducing waste treatments
- ☺ Reduction of water consumption
- ☺ Reduction of the volume of waste water
- ☺ Reduction of effluent load, basically by avoidance of the use of phosphorus-based and nitrogen-based cleaning agents
- ☹ Staff training cost

Table 4. High and low pressure systems

	HIGH PRESSURE SYSTEMS	LOW PRESSURE SYSTEMS
Operative diagram		
Operative characteristics	Pressure value: 68 kg/cm² Cleaning agent: pressurized water or solution	Pressure value: 6.8 kg/cm² Cleaning agent: Foam layer over the equipment surface
Advantages	Available system to remove the adherent dirt, impurities or any others foreign or undesired matter. Available system to remove the adherent dirt inside fissures. High efficiency at short-distance.	High efficiency system to remove the adherent dirt. Available system when spillage must be avoided, in small rooms or equipment that require wet-cleaning processes. Production of high quality foam: compact and firm foam. The equipment is cheaper and simpler to operate than high-pressure equipment. Avoidance of aerosol generation and reduction of spillage-related accidents.
Disadvantages	Machine and equipment aggressive cleaning-system. Equipment could be damaged. Dirt dispersion and spill-accidents due to the high pressure applied. Hard operative systems. Generation of hazardous aerosols. Production of a poor quality foam. High temperature losses depending on the applying distance.	Water consumption in low-pressure systems is greater than in high-pressure systems, but less than in manual cleaning processes.
Application area	Walls and outdoor areas	Equipment and production areas

CPO-3. IMPLEMENTATION AND IMPROVED OPERATION OF CIP EQUIPMENT

1) Type of Cleaner Production Option

On-site reduction of resource consumption. Technology changes.

2) Environmental issue

Cleaning is one of the most water-consuming operations, typically accounting for 25-40% of the total water consumption in a dairy industry.

The pollutant load of cleaning wastewater is considerable, due to the presence of milk fat and proteins, as well as detergents and disinfectants.

3) Cleaner Production opportunities

3.1. *Cleaning systems*

Production equipment is typically cleaned by pumping rinse water and cleaning solution through all equipment components. Some equipment has built-in cleaning nozzles that improve the utilisation of the cleaning solution. The cleaning solution that leaves the vessel can be either discharged or pumped to another vessel. With the use of cleaning-in-place (CIP) equipment, however, it is possible to use less cleaning solution and it is also possible to collect significant amounts of cleaning water. Both treatments allow for savings in both detergent and water (see Figure 5).

Modern CIP systems often involve the use of four tanks (see Figure 4):
- one for hot water rinsing
- one for alkaline cleaning solution (caustic soda)
- one for acidic rinses (nitric acid)
- one for collecting the final rinse water

Steam is often used to heat the cleaning solution. The items of equipment to be cleaned are isolated from product flows and the prepared cleaning solutions are pumped through the vessels and pipes.

Cleaning is one of the most water-consuming operations, typically accounting for 25-40% of the total water consumption in a dairy industry

3.2. *Implementation and improved operation of CIP equipment*

For dairies without CIP systems, consideration should be given to their installation. CIP systems make the recovery and reuse of cleaning solution possible, and systems equipped with in-line monitoring can control the quality of cleaning solution, thereby maximising the use of detergents and minimising water use.

For dairies with CIP equipment, it is important to determine and maintain optimum operational settings to reduce the consumption of both water and detergents.

Solutions to increase CIP systems efficiency:

a) Water reductions can be achieved by providing for the collection of final rinse waters to be reused as the initial rinse water in the next CIP cycle.
b) Monitoring equipment to control the consumption of detergents and disinfectants.
c) Setting optimum detergent concentration.
d) Solid waste, such as curd particles in the cheese-making plants, can be collected using a brush or broom rather than being rinsed down the drain, to avoid the consumption of large quantities of water.
e) The use of pigging systems, to remove product residues from the internal surfaces of pipelines prior to cleaning, can help to reduce the pollutant load of cleaning waste water and also allow for product recovery.
f) Use of "one-shot" cleaning solutions.

4) Economics and environmental evaluation

- ☺ Reduction of water consumption
- ☺ Improvement in the utilisation of cleaning solution
- ☺ Reduction of energy consumption
- ☺ Reduction of waste water effluent discharge
- ☺ Reduction in the generation of air emissions
- ☺ Avoidance of the use of phosphorus-based cleaning agents

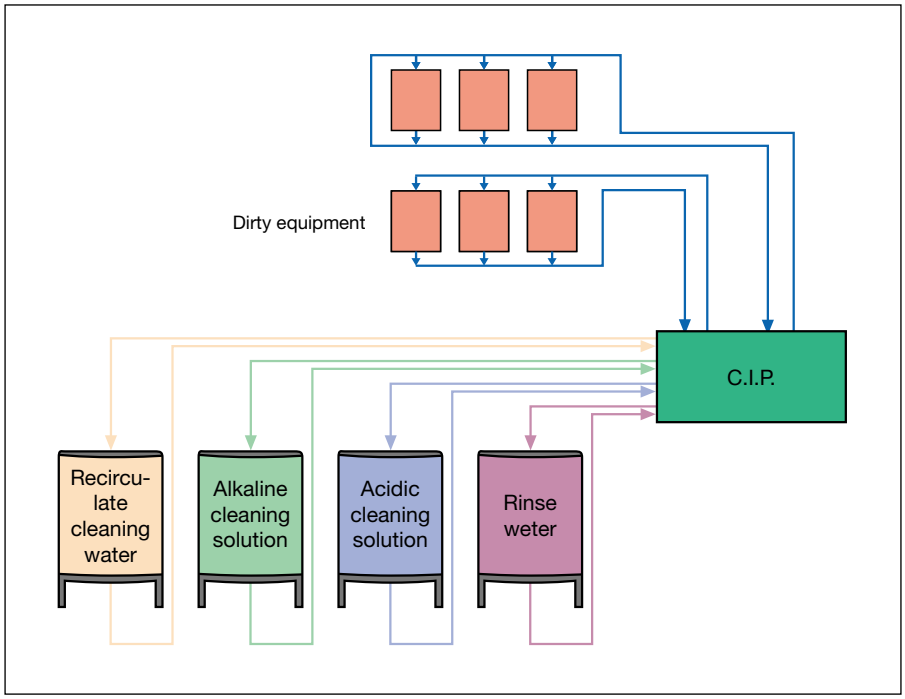


Figure 4. CIP systems diagram

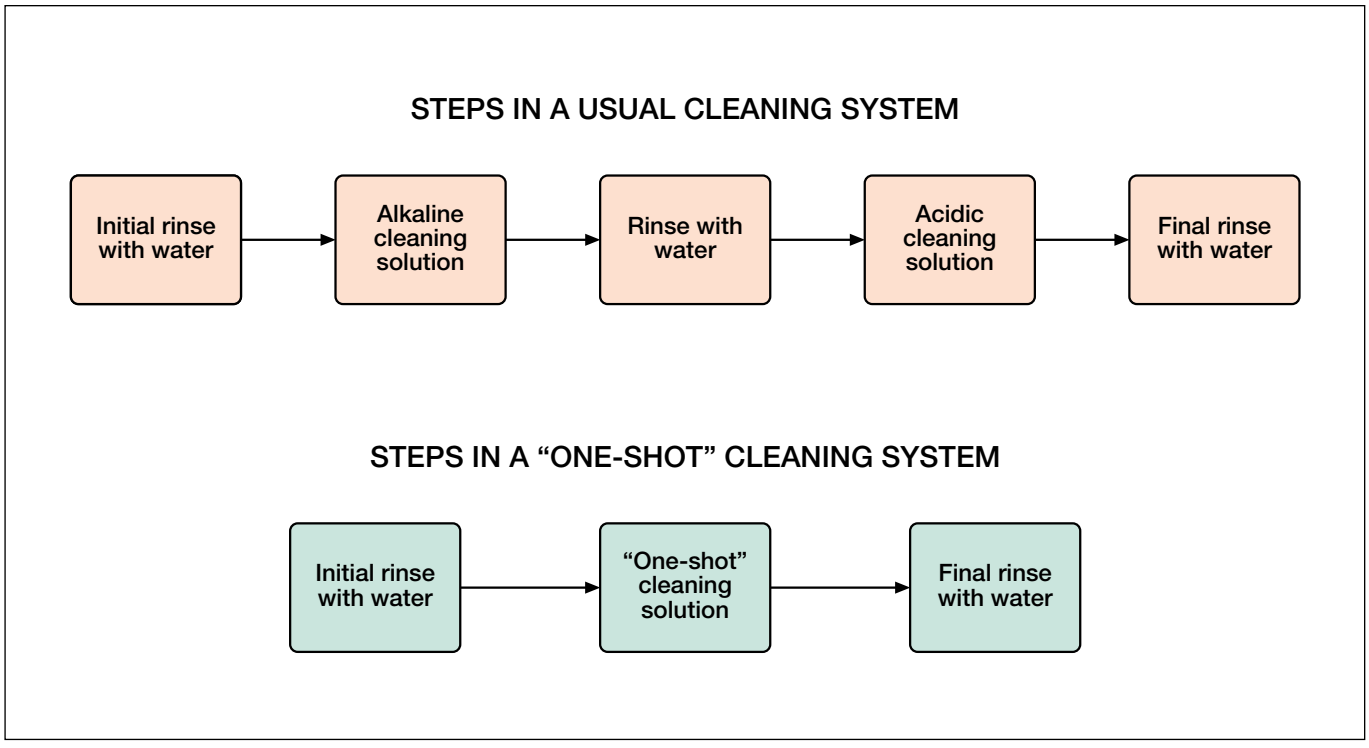


Figure 5. Comparison between the set sequences of cleaning systems

CPO-4. PRODUCT RECOVERY FROM PIPELINES

1) Type of Cleaner Production Option

On-site reduction of resource consumption. Good housekeeping.

2) Environmental issue

Dairy processing effluent contains predominantly milk and milk products which have been lost during the process. Milk loss can be as high as 3-4 %, with the main source of loss being residues which remain on internal surfaces of vessels and pipes. Usually, these residues are drained off with the rinse waters, increasing the organic load of the resulting effluent.

3) Cleaner Production opportunities

Implementation of product recovery systems.

Use starch plugs or pigs to recover product from pipes before internal cleaning of tanks.

System set sequences (see Figure 7):

Step 1. Production

The pig is firmly held in position in the launching station and flooded by the product.

Step 2. Product push-out

The pig is pressed through the pipe by means of a driving medium and pushes the product into the filler.

Step 3. Product push-out finish

Detection of the pig position via a magnetic switch outside the pipe.

Step 4. Pig return

The pig leaves the receiving station and is returned to the launching station by the driving medium.

Pig: inert and flexible body made of wear- and temperature-resistant, product-compatible material. Its contours allow safe cleaning of the entire surface; its shape ensures an optimal pasage through small and large pipe bends and tees.

Driving medium: it could be water, air, CO_2 or N_2.

4) Economics and environmental evaluation

- ☺ Financial benefits from product sale
- ☺ Cost savings from reducing the waste treatments
- ☺ Cost savings from reducing the waste water treatment
- ☺ Reduction of waste streams
- ☺ Reduction of waste water load
- ☺ Reduction of rinsing water consumption
- ☹ Capital cost to invest in compressed-air systems
- ☹ Capital cost to invest in new process equipment

Figure 6. Pig and pig cleaning station (GEA, Liquid Processing Division)

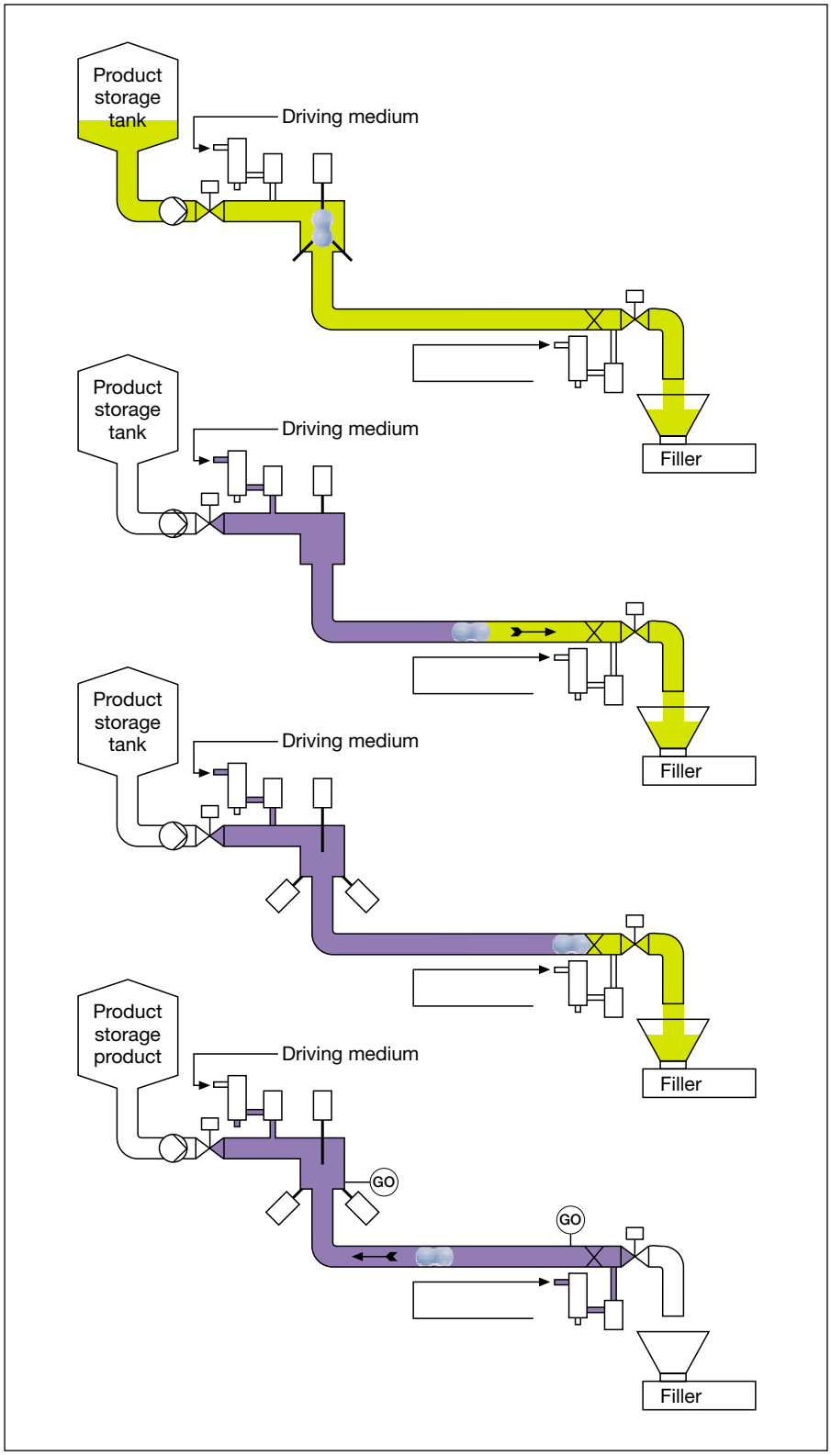


Figure 7. Set sequences of product recovery systems

CPO-5. OPTIMISATION OF HOT WATER PRODUCTION PROCESS

A primary system for the generation of hot water by the capture and recovery of low-grade energy/heat from rinsing waters reduces energy consumption

1) Type of Cleaner Production Option

On-site recycling.

2) Environmental issue

The cleaning processes of equipment and work areas in the dairy industry require large quantities of hot water to maintain hygienic conditions (water temperature about 70-80°C).

Steam, which is used for heat treatment processes is generally produced in on-site boilers. This process is the one that produces the majority of air pollutants which are formed from the combustion of fossil fuels.

3) Cleaner Production opportunities

Implementation of a primary system for the generation of hot water by the capture and recovery of low-grade energy/heat from rinsing waters.

4) Economics and environmental evaluation

- ☺ Reduction of energy consumption
- ☺ Reduction of air emissions
- ☹ Capital cost to invest in new process equipment

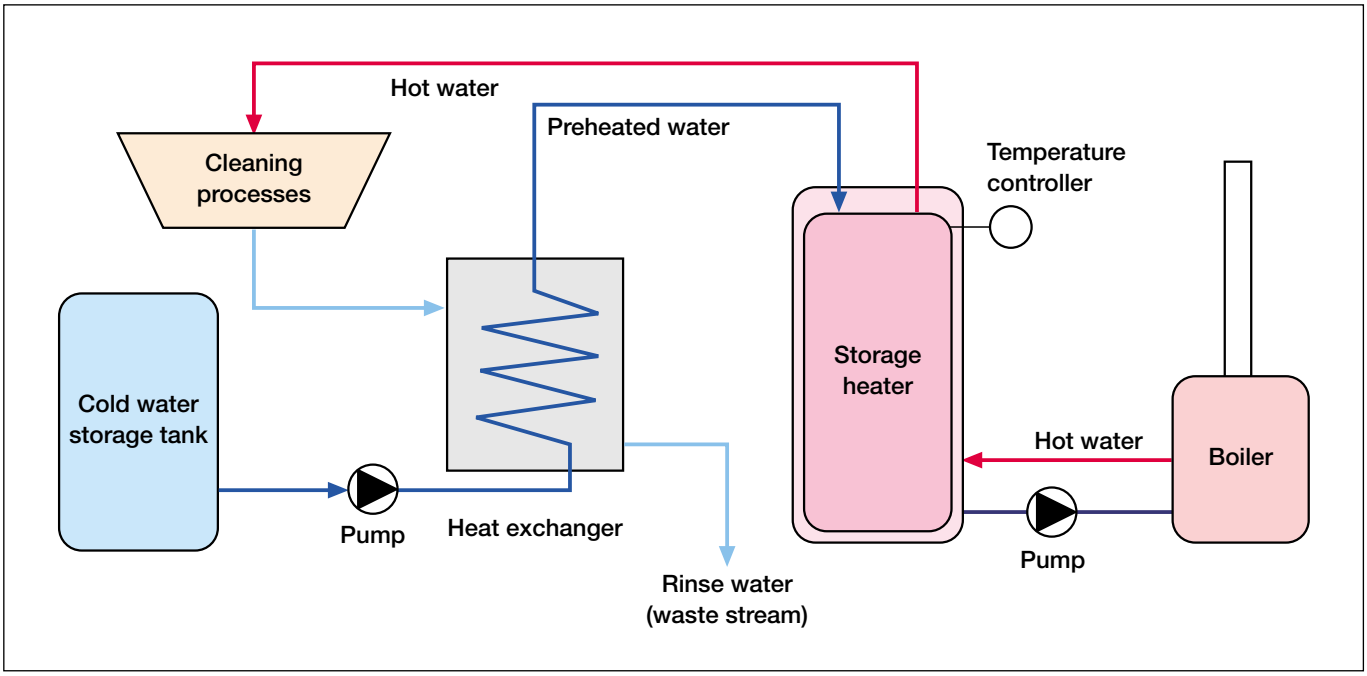


Figure 8. Equipment and flows involved in a primary system for generating hot water by capture and recovery of low-grade energy/heat from rinsing waters

CPO-6. REDUCTION OF ENERGY CONSUMPTION IN HEAT TREATMENTS: PASTEURISATION AND STERILISATION

1) Type of Cleaner Production Option

On-site reduction of resource consumption. Technology changes.

2) Environmental issue

The main environmental issue associated with heat treatments is the high level of energy consumed for heating and cooling the milk.

3) Cleaner Production opportunities

Energy consumption optimisation and improving the energy-efficiency of heat treatment through the implementation of heat recovery systems.

The plate heat exchanger systems consist of three important sections:

1. The regeneration section in which the raw milk is preheated by the milk coming from the heating section.
2. The heating section in which the preheated milk is brought up to heat treatment temperature by hot water or steam.
3. The cooling section in which the milk is cooled by chilled water.

The advantage of "regeneration-heating" systems is is that large quantities of heat can be recovered through the optimal arrangement of plate and flow rates.

Optimal energy-efficient values are achieved when:

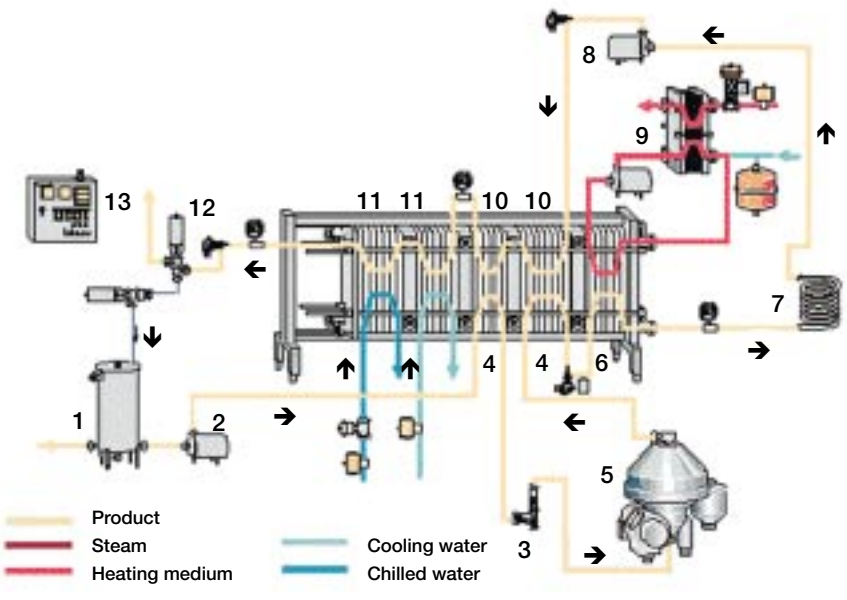
- Hot liquid to cold acts as heating fluid.
- Cold liquid to hot acts as cooling fluid.

The heat recovery percentage values could be up to 90%.

Example for calculation

Pasteuriser with 85% heat recovery versus pasteuriser with 92% heat recovery. Data:

- Temperature of incoming milk: 4°C
- Temperature to which milk is heated: 74°C
- Final temperature of heated milk: 4°C
- Working hours: 3 hours/day; 222 days/year
- Cost of fuel oil: 0.36 €/l
- Flow rate: 10,000 l/h
- Cost kWh: 0.1021 €
- Milk density ≃ 1 kg/l



1. Level tank
2. Feed pump
3. Flow meter
4. Heating regenerated section
5. Centrifugal equipment
6. Heating section
7. Constant temperature section
8. Pump
9. Water heating system
10. Cooling regenerated section
11. Cooling section
12. Valve
13. Control panel

Figure 9. Heat recovery system

Energy-consumption in the heating process

DATA	EQUIPMENT WITH 85% HEAT RECOVERY	EQUIPMENT WITH 92% HEAT RECOVERY
Heating temperature increment	74°C – 4°C = +70°C	74°C – 4°C = +70°C
Heat transfers from the incoming hot liquid	70°C x 85% = +59.5°C	70°C x 92% = +64.4°C
Overall heat transfer value for heating sections	70°C – 59.5°C = +10.5°C	70°C – 64.4°C = +5.6°C
Fuel oil consumption	$\frac{1\ kcal/kg\cdot°C\cdot 10.5°C\cdot 10{,}000\ l/h}{6{,}000\ kcal/l} = 17{,}5\ litres/h$	$\frac{1\ kcal/kg\cdot°C\cdot 5.6°C\cdot 10{,}000\ l/h}{6{,}000\ kcal/l} = 9{,}3\ litres/h$

Energy-consumption in the cooling process

DATA	EQUIPMENT WITH 85% HEAT RECOVERY	EQUIPMENT WITH 92% HEAT RECOVERY
Cooling temperature increment	4°C – 74°C = –70°C	4°C – 74°C = –70°C
Heat absorbed by the incoming cold fluid (% of regeneration)	–70°C x 85% = –59.5°C	–70°C x 92% = –64.4°C
Overall heat transfer value for cooling section	59.5°C – 70°C = –10.5°C	64.4°C – 4°C – 74°C = –5.6°C
Electricity consumption (kWh/h)	$\frac{1\ frig/kg\cdot°C\cdot 10.5°C\cdot 10{,}000\ l/h}{2{,}500\ frig\ /kWh} = 42\ kWh/h$	$\frac{1\ frig/kg\cdot°C\cdot 5.6°C\cdot 10{,}000\ l/h}{2{,}500\ frig/kWh} = 22{,}4\ kWh/h$

Equipment cost:

DATA	EQUIPMENT WITH 85% HEAT RECOVERY	EQUIPMENT WITH 92% HEAT RECOVERY
Equipment cost	36,000 €	42,000 €

Total cost and payback periods:

DATA	EQUIPMENT WITH 85% HEAT RECOVERY	EQUIPMENT WITH 92% HEAT RECOVERY
Annual cost of heating processes	3 h x 222 days x 17.5 litres/h x 0.36 €/l = **4,196 €**	3 h x 222 days x 9.3 litres/h x 0.36 €/l = **2,230 €**
Annual cost of cooling processes	3 h x 222 days x 44 kWh/h x 0.10 €/kWh = **2,930 €**	3 h x 222 days x 24.2 kWh/h x 0.10 €/kWh= **1,612 €**
Total annual cost	**7,126 €**	**3,842 €**

Heat exchanger with 92% heat recovery payback period: 1.8 years. Payback period for working time of 1 hour/day: 5.8 years.

4) Economics and environmental evaluation

- ☺ Reduction of energy consumption
- ☺ Reduction of air emissions
- ☹ Capital cost to invest in new process equipment.

Conclusions:

The implementation of the alternatives presented in this article should be analysed based on the specific circumstances of each company. Whilst some of these alternatives can be applied to any type of business, as they require only a minimal initial investment and do not suppose significant modifications of production lines, other alternatives will only be economically viable in those companies that have high production volumes, or those where a new production line is being designed which will allow for the inclusion of such improvements.

Regardless of the size of any such changes, their progressive implementation allows companies to integrate a policy of improvement of production procedures from both an economical and an environmental stance.

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PRATIQUES ET TECHNIQUES DE PRODUCTION PLUS PROPRE DANS L'INDUSTRIE LAITIÈRE

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Les principaux aspects environnementaux associés aux processus de production mis en place dans les industries du secteur laitier sont la consommation élevée d'eau et d'énergie et l'émission de courants résiduaires liquides présentant une charge organique importante. L'introduction de pratiques de production plus propre permet aux entreprises de réduire les coûts entraînés tant par la consommation excessive de ressources que par le traitement en fin de ligne des courants résiduaires générés.

Cet article décrit de façon détaillée quelques possibilités de prévention de la pollution introduites avec succès dans des entreprises du secteur laitier, notamment :

1. La récupération et la valorisation du petit-lait
2. L'optimisation du système de nettoyage CIP
3. L'optimisation des opérations de nettoyage des installations et des surfaces
4. La récupération des restes de produit dans les conductions
5. L'optimisation de la production d'eau chaude pour les divers processus
6. L'optimisation des pourcentages de récupération de la chaleur dans les traitements thermiques de pasteurisation et de stérilisation UHT

Mots-clé : Production plus propre, industrie laitière, petit-lait de fromage, consommation d'eau, consommation d'énergie, CIP (nettoyage en place).

PRÁCTICAS Y TÉCNICAS DE PRODUCCIÓN MÁS LIMPIA EN LA INDUSTRIA LÁCTEA

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Los procesos productivos desarrollados en las industrias del sector lácteo tienen asociados como principales aspectos medioambientales las elevadas cantidades de agua y energía consumidas y la emisión de corrientes residuales líquidas con una carga orgánica significativa. La implantación de prácticas de producción más limpia permite a las empresas reducir los costes que conllevan tanto el consumo de recursos en exceso como el tratamiento al final de línea de las corrientes residuales generadas.

En este artículo se describen de forma detallada algunas oportunidades de prevención de la contaminación que han sido implantadas con éxito en empresas del sector lácteo, como son:

1. La recuperación y valorización del suero
2. Optimización del sistema de limpieza CIP
3. Optimización de las operaciones de limpieza de instalaciones y superficies
4. La recuperación de producto retenido en conducciones
5. Optimización en la producción de agua caliente para los procesos
6. Optimización de los porcentajes de recuperación de calor en los tratamientos térmicos de pasteurización y esterilización UHT

Palabras clave: Producción más limpia, industria láctea, lactosuero, consumo de agua, consumo energético, CIP (limpieza *in situ*).

TRANSFER OF ENVIRONMENTALLY SOUND TECHNOLOGY (TEST): UNIDO INITIATIVE IN THE MEDITERRANEAN BASIN

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The Mediterranean Basin suffers intense environmental pressure. Industry is a major contributor to this pressure, yet entrepreneurs are frequently loath to implement sustainable practices for fear that this would affect their profits and competitiveness. This article explains the UNIDO TEST Programme (Transfer of Environmentally Sound Technology), which aims to show industry that economic and environmental concerns are compatible. It presents the experience gained when implementing the TEST approach in the Danube Basin and the framework for carrying out the TEST approach in the Mediterranean Basin.

Key words: Environmental pressure, environmentally sound technology, TEST approach, management pyramid, implementation strategy, Sustainable Enterprise Strategy.

Introduction

The Mediterranean basin, with its limited and fragile natural resources, is characterized on its Southern and Eastern rim by recent socio-economic developments that have given rise to major changes that are putting its environment under intense pressure. Population trends, indicating that a population of 410 million in 1994 may rise to 550 million in 2025, together with modern means of production and consumption, are playing a major role in these changes.

Industry is a strong component of these environmental pressures. Since the 1970s, industrialization has proceeded apace in the Mediterranean countries, although the technologies in use are often obsolete and generate considerable pollution. As a result, industry consumes excessive amounts of natural resources and energy and generates excessive amounts of waste and pollution. What is needed is sustainable industrial development that takes into account not only economic considerations, but also environmental and social ones. However, very often entrepreneurs cannot visualize a transformation of their enterprises to sustainable patterns that have a positive impact simultaneously on their financial, social and environmental performance. Instead, they feel that there must necessarily be a trade-off between their enterprises' environmental and social performance and their financial performance; either they are environmentally friendly and/or socially progressive (an "ethical business") at the expense of lower profits and competitiveness, or they are competitive at the expense of environmental degradation and poor social conditions. This perception of a trade-off is particularly acute on the environmental side, since the solutions for environmental problems are seen by enterprises to be large, and non-productive investments in waste and pollution treatment and disposal.

Entrepreneurs still do not generally appreciate that environmental and social strategies can actually result in considerable competitive advantages and reveal significant potential for profit maximization. Economic activities and environmental and social concerns are not diametrically opposed but can complement one another. UNIDO's TEST programme is aimed at demonstrating this to enterprises and supporting industries, in a practical way in the developing countries and countries with economies in transition; the programme provides them with the tools and support they need in order to reap these benefits.

THE UNIDO TEST PROGRAMME

The international technical cooperation community has supported only a few practical demonstration projects of environmentally sound technology, and unfortunately these have usually focused exclusively on environmental issues rather than integrating economic, social and environmental concerns. Nor has much effort been made in these demonstration projects to enhance the technical capacities of the countries involved in order to provide enterprises with an integrated package of technical services that would be more attractive and helpful to them.

Although there is the capacity in developing countries and countries with economies in transition to provide many of the services needed by industry to adopt sustainable transformation, this capacity is often isolated in individual institutions and companies. There is a lack of appreciation in the professional community of the synergies to be achieved in the collective provision of services to enterprises. These synergies result in solutions for enterprises that meet their needs more completely, and can be provided at a more reasonable cost than if they are provided as individual services.

In light of this, in 2001 the United Nations Industrial Development Organization (UNIDO) designed the TEST programme, which is a new approach to technical cooperation that enhances the contribution of industry to sustainable development through the promotion of integrated solutions addressing both the causes of low productivity, and those of environmental risks in industry. Such integrated solutions are in line with the definition of ESTs as first defined by the United Nations Conference on Environment and Development (UNCED) in Rio in 1992[1] and reconfirmed by the World Summit on Sustainable Development (WSSD) in Johannesburg, in 2002.[2]

The successful results achieved at the pilot industrial sites serve as a demonstration to other enterprises, thus generating a demand for these kinds of services

The aim of the programme is to assist enterprises in developing countries and countries with economies in transition, to significantly improve their environmental performance whilst at the same time increasing their competitiveness and maintaining their social performance. This is achieved by providing them with a flexible approach towards environmental management, which utilizes the synergies between different and complementary tools.

A TEST project in a country or region acts on three levels. It:

- Addresses the need to enhance the capacities of institutions that are concerned with industrial environmental management issues, thereby enabling them to offer enterprises an integrated package of technical services best tailored to their needs.
- Demonstrates the effectiveness of the UNIDO integrated TEST approach at pilot industrial sites.
- It supports the dissemination of the methodology and results at national and regional levels.

Sustainability of the TEST approach in the chosen country or region is assured by two mechanisms: a) by building a national capacity to provide services to implement the TEST approach, which can be made available to any enterprise in the country or region; b) by developing the demand for a TEST approach at enterprise level through peer pressure. The successful results achieved at the pilot industrial sites serve as a demonstration to other enterprises, thus generating a demand for these kinds of services. Replicability of the lessons learned is assured by cascading through a 'train the trainers' mechanism put in place by UNIDO during project implementation. The experience gained by the local institutions will be made available to other enterprises.

1 "ESTs encompass technologies that have the potential for significantly improved environmental performance relative to other technologies. Broadly speaking, these technologies protect the environment, are less polluting, use resources in a sustainable manner, recycle more of their waste and products, and handle all residual wastes in a more environmentally acceptable way than the technologies which they substitute. ESTs are not just individual technologies, but total systems which include know-how, procedures, goods and services, and equipment, as well as organizational and managerial procedures."

2 The "Johannesburg Plan of Implementation", which stresses the need to reduce unsustainable patterns of production and consumption, calls for urgent action to promote, facilitate and, when appropriate, finance the development, transfer and dissemination of ESTs and the corresponding know-how to and amongst developing countries.

THE INTEGRATED TEST APPROACH

UNIDO's integrated TEST approach builds on the positive experience the Organization has gained from implementing individual approaches, especially in the fields of cleaner production (through its National Cleaner Production Centre (NCPC) programme) and environmental management, but also in the fields of enterprise development and entrepreneurship. The approach uses the preventive approach of cleaner production (systemic preventive actions based on pollution prevention techniques within the production process), and progresses to the transfer of additional environmentally sound technologies for pollution control (end of pipe) only after the win-win solutions of cleaner production have been fully explored. This leads to an environmental and financial optimisation of the transferred technologies. The TEST approach also addresses industrial environmental management in an integrated way. It provides tools for optimising the key components of any enterprise, with a particular focus on environmental issues and performance. These components can be shown in the form of a management pyramid.[3]

The base of the pyramid is formed by the values and expectations of the stakeholders and their relationships with an enterprise. The main stakeholders are the owners and/or managers of the enterprise, its customers, its workers, its suppliers, the authorities, and the communities that live alongside. From this base is derived the next level of the pyramid, namely the vision, mission and core values of the enterprise. This level represents the leading ideas and intentions that guide any enterprise. The next two levels of the pyramid are formed by the strategies the enterprise adopts to achieve its vision and goals, and by management systems that steer the enterprise's operations.

The latter includes the organizational structure and means for decision-making. The operational level describes the enterprise's means of production and its performance. Finally, the top level of the pyramid is made up from the outputs of the operational level – the products and services and performance (but also the non-product outputs such as waste, pollution and risk).

The last output level connects back to the base of the pyramid: the outputs determine the perception that the different groups of stakeholders have of the enterprise, and consequently their relationship with it. It can be seen that the loop built through the management pyramid can easily create a vicious circle that is difficult to break. For instance, bad economic performance due to poor sales, and/or problems with the authorities due to poor environmental performance, all framed by uncertain socio-economic conditions reinforce an enterprise's vision and strategy that is short-term and reactive. The lack of long-term vision prevents the enterprise from making important strategic decisions and taking risks. These pressures also block changes needed within the management system, and prolong the use of inefficient operation systems. The changes that are implemented in these instances are the result of crisis management and are not of a systemic nature. The loop closes here, as

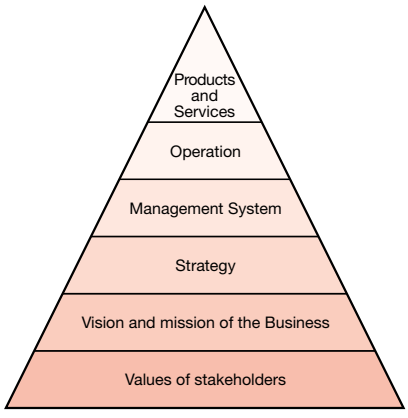

Figure 1. The management pyramid

3 Usually the management pyramid is drawn in the opposite order, with values and vision at the top, and operating system at the bottom of the pyramid. In the TEST approach, an opposite logic of building up the pyramid is used, where the values and expectations are used as the baseline core layer on which all the others are built (following the logic of the corporate Sustainability report of ITT Flygt:), as this is more reflective of reality.

the results are low-quality products and pollution, which makes the relationship between the enterprise and its stakeholders even worse. This further deepens the crisis characteristics of the short-term reactive vision and strategy, and so on.

The primary objective of a TEST project is to help enterprises to break out of such vicious circles and actually turn them into virtuous circles. It helps them to comply with, or even go beyond, the environmental standards required of them whilst simultaneously enhancing their competitiveness and maintaining their social commitments.

The core principles of the TEST approach are the following:

- It is based on a voluntary commitment by enterprises to proactive environmental management;
- It is problem-driven, focusing on the needs of enterprises and/or countries;
- It is flexible and open to innovative solutions – the specific tools used in any specific TEST project are selected and introduced on the basis of an initial review of the needs of the enterprise;
- It uses the Integrated Pollution Prevention and Control (IPPC) and Best Available Techniques (BAT) approaches;
- It focuses on optimising production processes through material efficiency strategies, followed by the design of, what are now, less onerous end-of-pipe solutions, if they are indeed needed;
- It ensures that implementation of identified measures and monitoring of project results are an integral part of any TEST project;
- It analyses problems in their economic, social and environmental complexity.

The primary objective of a TEST project is to help enterprises to break out of such vicious circles

TEST IMPLEMENTATION STRATEGY

A TEST project uses a set of tools that will fit into the pyramid management structure and act at different levels. The basic set of tools used, as well as the general implementation scheme of a TEST project, is shown in figure 2. The TEST approach posits that the use of tools, such as cleaner production assessments (CPA), environmental management systems (EMS) and environmental management accounting (EMA), within an integrated framework will result in greater synergies and better results for an enterprise. Not all the tools have to be used in an enterprise. Those required will depend on the specific situation of the enterprise, management decisions, and availability of internal human resources.

The implementation strategy of a TEST project is organized into three main stages as described in figure 2.

During the first stage, national focal points are selected and introduced to the TEST approach. Capacity building is also undertaken during each stage of the project. The next step is to promote the TEST project concept within chosen industrial sectors or sub sectors, for identification of participating enterprises. A shortlist of potential enterprises is prepared, and an initial review is undertaken. The latter consists of two sets of assessments: the market and financial viability and the initial environmental review. The initial review is the step where areas of improvement are identified and initial targets of the project are set.

Based on the findings of the initial review, the introduction of the TEST tools in the participating enterprises starts in the second stage, which is organized into three phases. During the first phase, different "soft" environmental management tools, such as CPA, EMS and EMA, are introduced and integrated into the enterprise's daily operations. Improved operation of existing processes or technologies is achieved, resulting

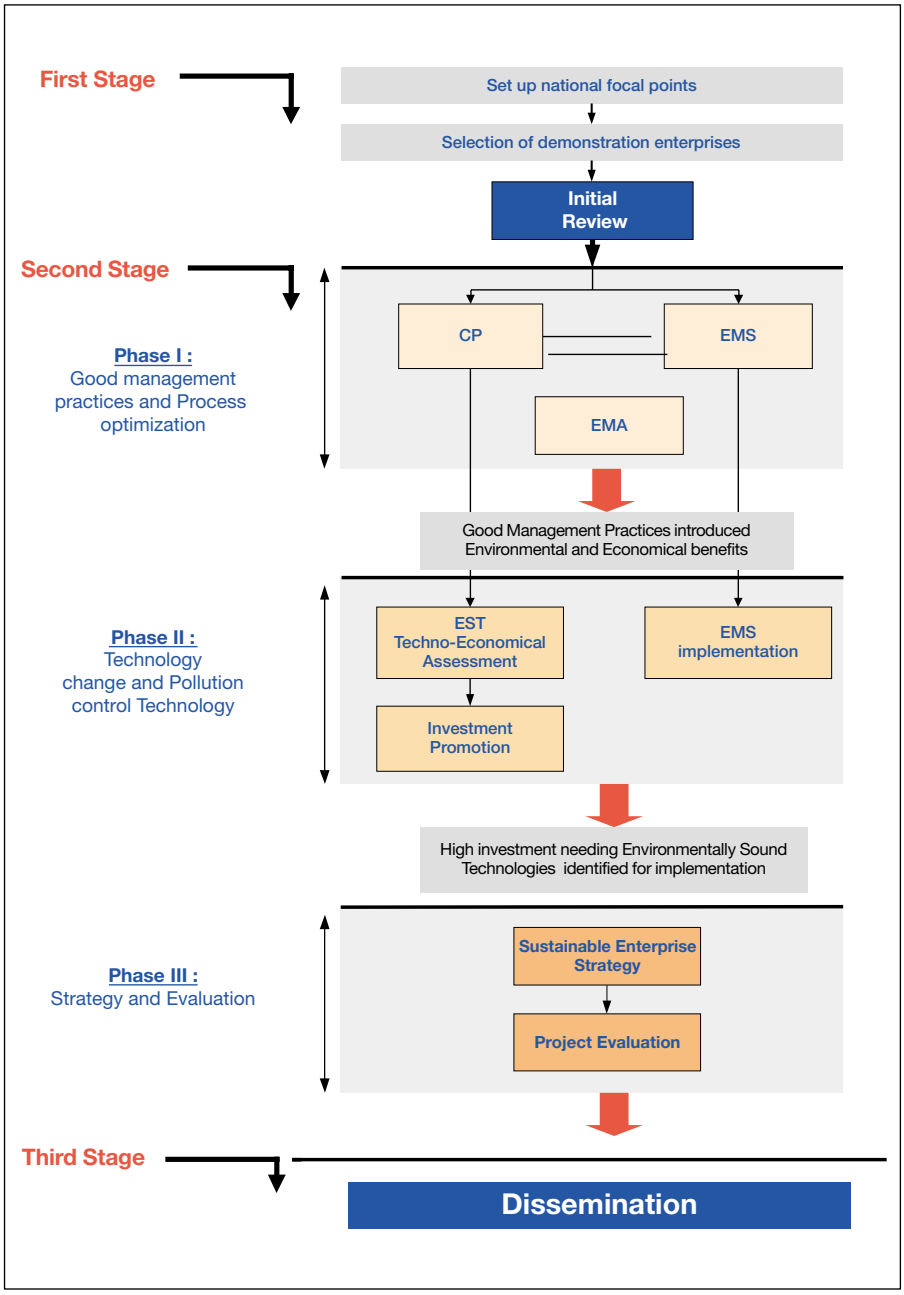

Figure 2. TEST implementation strategy

in financial and environmental benefits. TEST includes a methodology that combines the simultaneous introduction of these tools, as will be described in the next section. Experience shows that combining the use of tools such as CPA, EMS and EMA within an integrated framework results in better synergies and more positive results. Nevertheless, the tools can also be implemented independently, according to the specific situation of the company.

The second phase of implementation of the TEST approach at enterprise level aims to identify the requirements in terms of environmentally sound technologies (EST) that require large investments. These technologies include cleaner technologies integrated into the production process as well as end-of-pipe solutions. During this phase, technical and economic evaluations of potential EST investment projects are prepared taking into account long-term environmental savings and benefits. Contingency environmental costs, due to expected changes in regulatory regimes or to potential risks for the environment, are also considered. At the end of this phase environmental considerations are incorporated into the investment decision-making process and managers are provided with pre-feasibility studies showing the higher profitability of combined CP/EST investments. Financing mechanisms for EST investments (existing environmental funds, green loans, etc.) are also identified, and limited technical assistance is provided to the enterprises on how to access cheap capital for their investment, and on application modes.

The third phase of enterprise level work, which aims at the sustainability of the TEST approach, focuses on reflecting the practical experience gained in the enterprise's strategies. An evaluation of project results is conducted, and, on the basis of this evaluation, the Sustainable Enterprise Strategy (SES) module is implemented to integrate the environmental and social dimensions into the enterprise's business strategies.

In the first phase, different "soft" environmental management tools, such as CPA, EMS and EMA, are introduced and integrated into the enterprise's daily operations

The third and final stage of a TEST project includes communication and dissemination of project results to other enterprises of concern. For UNIDO, the assistance given to the participating enterprises is only a means to ensure the sustainability and replicability of the TEST approach in the country once the project itself is completed. It does this in two ways. First, it disseminates the results obtained with the participating enterprises in order to give practical demonstrations to all other businesses in the country of the value to them of adopting the TEST approach. Second, it makes available to them – primarily through the national focal points – the capacity that has been built during the project to provide them with TEST-related services. On the one hand, the successful results of the project develop a demand for TEST-related services at the enterprise level through peer pressure. On the other hand, the practical experience gained through the project by the local institutions will create a supply of people that can offer TEST-related services to satisfy that demand.

Dissemination of the results achieved in a TEST project takes place in the following ways:

- Preparation of marketing material for the TEST approach. The marketing material would include the TEST manual along with case studies;
- Hosting national seminars in the countries involved in the project;
- Offering a one-day assessment at polluting enterprises to show them the potential benefits of applying the TEST approach in their enterprises;
- Introducing the TEST approach to other countries.

IMPLEMENTING THE TEST APPROACH IN THE DANUBE RIVER BASIN

1. Background

The TEST approach is currently being applied to address medium and large industrial polluters in five countries located in the middle-lower Danube Basin (Bulgaria, Croatia, Hungary, Romania and Slovakia). Enterprises in these countries are facing particularly serious financial problems because, while they are going through radical reshaping as they move towards market economies, they also have to respond to the environmental objectives of the Danube River Protection Convention (DRPC), and the environmental requirements that come with accession to the European Union; the most significant of these is the EU's IPPC Directive. The DRPC and the EU's IPPC Directive both require enterprises to apply best available techniques (BAT) and best environmental practices (BEP).

The TEST project, which is still ongoing, has targeted 17 hot spots of industrial pollution in the Danube River Basin and its tributaries caused by enterprises from various industrial sectors (chemical, food, machinery, textile, pulp and paper), out of 130 such hot spots identified in a GEF-funded UNDP project entitled "Pollution Reduction Programme for the Danube River Basin". The overall aim of the TEST project is to use some of these industrial polluters as pilot sites in which to implement the TEST approach, and show other enterprises that it is possible to reduce environmental impacts to acceptable levels and remain competitive or become even more competitive. The project is mostly funded by GEF, with some participation from UNIDO and other donors, and was developed under the umbrella of the Danube River Basin Commission. The project is using as national focal points: the national cleaner production centres (NCPCs) of Croatia, Hungary, and Slovakia (members of the UNIDO/UNEP network of NCPCs); the Institute for Industrial Ecology (ECOIND) in Romania; and the Technical University of Sofia in Bulgaria.

UNIDO is currently finalizing a TEST approach methodology guidebook and a set of national publications including a variety of case studies, which will be available in December 2003

On the basis of the experience gained in implementing the TEST project in the Danube river basin, UNIDO is currently finalizing a TEST approach methodology guidebook and a set of national publications including a variety of case studies. The publications will be available in December 2003.

2. Enterprise participation: barriers and challenges

Finding enterprises in the chosen hot spots was simple, given the previous UNDP project, but being in a hot spot was not a sufficient reason to request enterprises to join the project. What was much more challenging was to identify good pilot sites that would participate effectively in the project, and that were financially viable.

As indicated above, one of the major principles of the TEST approach is that involvement in a TEST project is voluntary. Therefore, local enterprises had to be convinced that they would gain from their participation in the project. Even if a small (token) financial contribution to the project was required of the pilot enterprises (to strengthen their commitment to the project), their participation was mostly subsidized by project funds, so financial commitments were not a problem. However, the TEST approach requires a significant commitment of human resources by enterprises for its successful implementation, and this was more of a

problem for them. Therefore, the marketing of the project concept required considerable effort. It was particularly important to find enterprises with a strong commitment to the project, to avoid the possibility that they would withdraw during project implementation.

To assure the ultimate success of the project (i.e. sustainability of the results obtained) final selection was also based on enterprise viability, defined as the potential for an enterprise to remain in business for more than five years given its market position and production costs. Only financially viable companies will undertake the necessary investment and upgrades in EST and will really care about having a long-term, sustainable strategy. This criterion eliminated several candidates, since they were found to be in a very difficult financial situation at the start of the project.

In spite of the difficult economic situation in these countries, and despite the lack of enforcement of environmental legislation, the required number of pilot enterprises was identified. What this phase of the project showed was that economic drivers are much stronger than environmental ones in this region of the world, and they are pushing companies in the direction of improving the efficiency of their operations and in acquiring EMS certification.

The identification of the correct drivers was very important, not only during the first phase when the project was being marketed and pilot sites were being selected, but also during the overall implementation of the project, to maintain management commitment. The marketing strategy that was employed was successful, although it required up to four months to be completed. Having the enterprises sign a Memorandum of Understanding with the national counterpart and having a (small) financial contribution from them for their participation in the project helped maintain management's commitment to the project.

This phase of the project showed that economic drivers are much stronger than environmental ones in this region of the world

The introduction of the integrated TEST approach, instead of the traditional step-by-step approach, represented a serious challenge, both for the participating enterprises as well as for the national focal points. Such an approach requires efficient planning of project activities and considerable coordination efforts by the national focal points: different activities were running and different teams of experts had to be guided simultaneously.

Moreover, the integrated approach underlying the TEST approach requires a significant involvement of an enterprise's human resources, from different departments. Two major barriers had to be overcome here. One was a lack of communication and cooperation between different departments, the other were conflicts with mid-level managers for the use of human resources for project activities (for them, production was often the first priority, particularly in the smaller enterprises).

It should be noted that none of the selected enterprises have withdrawn from the project, and even though they have each had different levels of success, all of them have achieved measurable results by undergoing the TEST approach. Primarily, this is because the project demonstrated one of the basic theses of the TEST approach very well, namely that improving environmental performance does not have to be at the expense of competitiveness. The most financially feasible measures, both organizational and technical, were identified to bring the enterprises into compliance with the environmental norms of the Danube River Protection Convention and the EU's IPPC Directive, whilst also accommodating their need to remain competitive.

IMPLEMENTING THE TEST APPROACH IN THE MEDITERRANEAN BASIN

On the basis of the satisfactory results being obtained in the Danube River Basin, UNIDO has decided to extend the TEST approach to other regions of the world. The Mediterranean Basin seemed particularly well adapted to a TEST project and the promotion of the TEST approach in general, specifically with reference to reducing the loads of industrial pollution entering the Mediterranean Sea.

Any activities that UNIDO conducts in this region must necessarily integrate into what has already been carried out. In particular, UNIDO's TEST approach must build on the Strategic Action Programme to address pollution from land-based activities (SAP), adopted by the Mediterranean countries in 1997. The SAP provides the framework for implementing the LBS Protocol and foresees the elaboration of National Action Plans (NAPs) to reduce pollution by the Mediterranean countries.

Moreover, a Transboundary Diagnostic Analysis (TDA) was undertaken throughout the Mediterranean Basin as coordinated by the regional programme of pollution monitoring and research (MED POL), and the Mediterranean countries were required to collect data on the priority pollution hot spots in the Mediterranean Basin; in 1997, a consolidated list of 101 such priority hot spots was prepared[4] and is now being updated. In the SAP, the Mediterranean countries adopted specific targets, namely:

- By the year 2025, to bring point sources of discharges and air emissions from industrial installations into conformity with the provisions of the LBS Protocol and other agreed international and national provisions;
- Over a period of 10 years, to reduce by 50% the discharges, emissions and losses from industrial installations of substances that are toxic, persistent and liable to bioaccumulate;

4 UNEP/WHO: Identification of Priority Pollution Hot Spots and Sensitive Areas in the Mediterranean. MAP Technical Reports Series No. 124. UNEP, Athens, 1999.

- Over a period of 10 years, to reduce by 50% discharges, emissions and losses of polluting substances from industrial installations in hot spots and areas of concern.

The national implementation strategies for reducing industrial discharge into the Mediterranean Sea require each country to: (I) finalize an inventory of point source discharges and emissions of pollutants in the hot spot areas; (II) prepare and adopt national regulations concerning point source discharges of industrial wastewater as soon as possible; (III) give priority to small and medium-sized enterprises, favouring the creation of associations in order to minimize waste generation; (IV) reduce discharges and emission of pollutants as much as possible by promoting the implementation of environmental audits, and applying BEP and BAT in industrial installations that are sources of pollutants.

A consolidated list of 101 priority hot spots in the Mediterranean Basin was prepared and is now being updated

The political will to minimize pollution of the Mediterranean Sea is represented by the adoption of the SAP by the countries involved

All this creates excellent conditions for the implementation of a TEST project in the countries around the Southern and Eastern rim of the Mediterranean Sea. As in the case of the Danube River Basin, hot spots of pollution, which include pollution from industrial sources, have been identified. The political will to minimize pollution of the Mediterranean Sea, especially in the hot spots, exists, and is represented by the adoption of the SAP by the countries involved and the National Action Plans (NAPs) when available. The TEST approach can allow the enterprises involved in these hot spots to minimize their impact on the Mediterranean Sea without this necessarily impacting on their financial health.

Initial funding for a TEST project in the Mediterranean has been obtained, and a proposal for co-funding by GEF will be submitted shortly. Initial activities are planned to start in late 2003, with activities aimed at identifying the national focal points. All activities under the project will be undertaken in strict collaboration with the Regional Activity Centres, especially the Regional Activity Centre for Cleaner Production (RAC/CP), as well as with the Mediterranean Action Plan (MAP), whose previous activities are the basis for the work being proposed through the TEST project.

TRANSFERT DES TECHNOLOGIES RESPECTUEUSES DE L'ENVIRONNEMENT (TEST) : INITIATIVE DE L'ONUDI DANS LE BASSIN MÉDITERRANÉEN

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Le Bassin méditerranéen supporte une pression environnementale intense. L'industrie contribue largement à cette pression, mais les entrepreneurs hésitent souvent à introduire des pratiques durables car ils craignent que cela n'atteigne ni leurs bénéfices ni leur compétitivité. Cet article explique le programme TEST (Transfert des technologies respectueuses de l'environnement) d'ONUDI, qui cherche à démontrer à l'industrie que les aspects économiques et les questions environnementales sont compatibles. L'article présente l'expérience acquise lors de l'introduction de la méthode TEST dans le bassin du Danube et le cadre pour mettre en place le programme TEST dans le bassin méditerranéen.

Mots-clé : Pression environnementale, technologie respectueuse de l'environnement, méthode TEST, gestion pyramidale, stratégie d'introduction, stratégie d'entreprise durable.

TRANSFERENCIA DE TECNOLOGÍAS RESPETUOSAS CON EL MEDIO AMBIENTE (TEST): LA INICIATIVA DE ONUDI EN LA CUENCA DEL MEDITERRÁNEO

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La cuenca del Mediterráneo está sometida a una intensa presión ambiental. Pese a que la industria es una de las principales responsables, los empresarios suelen mostrarse reacios a la implantación de prácticas sostenibles por miedo a que ello revierta en un descenso de sus beneficios y competitividad. En este artículo se explica el programa TEST de transferencia de tecnologías respetuosas con el medio ambiente, que forma parte de la iniciativa de ONUDI y cuyo fin es demostrar a la industria que los intereses económicos y ambientales son compatibles. El artículo presenta la experiencia obtenida al llevar a cabo la iniciativa TEST en la cuenca del Danubio así como el marco para desarrollar el programa TEST en la cuenca mediterránea.

Palabras clave: Presión ambiental, tecnología respetuosa con el medio ambiente, programa TEST, pirámide de gestión, estrategia de implantación, estrategia de empresas sostenibles.

INSTRUCTIONS TO AUTHORS

Send a print copy and a clean diskette or an attachment by e-mail containing the article, tables and figures to:

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The **Mediterranean Action Plan (MAP)** strives to protect the environment and to foster development of the Mediterranean Basin. It was adopted in Barcelona (Spain) in 1975 by Mediterranean States and the EC, under the auspices of the United Nations Environmental Programme (UNEP). Its legal framework is made up of the Barcelona Convention (1976, revised in 1995) and six Protocols covering certain specific aspects of environmental protection. The Action Plan is built up around an Athens-based Coordinating Unit, the MED POL Programme and six Regional Activity Centres.

The **Regional Activity Centre for Cleaner Production (RAC/CP),** based in Barcelona-Spain, was established in 1996 with the aim of disseminating and promoting the concept of cleaner production, along with the opportunities and advantages of pollution prevention in the industrial activities in Mediterranean countries. The RAC/CP activities are financed by the Spanish Government once they have been submitted and approved by the Contracting Parties to the Barcelona Convention and by the Bilateral Monitoring Commission made up of representatives from the Spanish and Catalan Governments.

This technical publication is issued yearly by RAC/CP. It is aimed at providing an information exchange system among experts in the Mediterranean region with articles related to cleaner production and waste minimisation. It is intended as a technical publication and does not necessarily reflect the official view of RAC/CP.