LIFE III

focus




Industrial pollution, European solutions: clean technologies

LIFE and the Directive on integrated pollution prevention and control (IPPC Directive)

European Commission

European Commission
Directorate-General Environment

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summary

No-one doubts that industrial activity is essential for the economy, citizens' well-being and maintenance of employment. However, data from the European Environment Agency[1] show that the state of the environment continues to deteriorate in various fields. Despite remarkable progress made in recent decades in virtually all industrial sectors in terms of ecological efficiency of production processes, a great deal remains to be done before we will have reached a sustainable standards. We need to reduce substantially atmospheric emissions - in particular those contributing to climate change - and water pollution, water and energy consumption, the use of toxic substances, the quantity of non-recyclable waste, etc.

One of the key methods for meeting this challenge is through technological development. This involves improving the capacity of industry to innovate. In order to stimulate this preventive approach, the European Union's policy combines legislative requirements, R&D and financial support for innovative projects, in particular LIFE-Environment projects.

At the legislative level, every operator of a major industrial installation must apply the "*best available techniques*" *(BAT)* to prevent or substantially reduce adverse effects on the environment. This obligation – soon to be applicable throughout the Europe of the Twenty-Five – is laid down in the integrated pollution prevention and control directive. The European Commission recently published a communication on its implementation. It called upon the Member States to enhance their efforts and has organised large-scale consultation[2].

LIFE provides industrial innovators with support that may be decisive, in particular within small and medium-sized industries, in demonstrating the feasibility of promising technologies and ensuring dissemination of positive results. Several LIFE projects in various sectors have already contributed to improving manufacturing processes and others are in progress. This brochure highlights examples of the role which LIFE plays in stimulating clean technologies. This role will be further strengthened through the LIFE-Environment projects selected in 2003. There are twice as many projects focusing on such technologies and on reducing the greenhouse effect as in 2002, representing more than 16% of the total.

[1] *http://www.eea.eu.int*
[2] *See page 8: "For more information and for contact".*

Clean technologies: proof through LIFE

Many LIFE projects embrace the development of clean technologies in industry. More than thirty of these have specifically contributed to establishing «best available techniques», a key element of the integrated pollution prevention and control directive which is one of the main legislative instruments of the Union ensuring sustainable development.

Action at source, and in particular at production sites, is an essential condition for the success of endeavours to reduce the environmental impact of economic activities. Priority should be given to choosing innovative techniques that are geared to prevention. It is also important not to consider problems separately but from an overall environmental point of view: air, water, soil, natural resources, etc. This two-pronged approach, both innovative and integrated, is characteristic of LIFE projects. Many of them contribute to the development of **clean technologies** in a wide range of industrial sectors.

Clean technologies, LIFE and the IPPC Directive

Clean technologies are new industrial processes or modifications of existing ones intended to reduce the impact of production activities on the environment, including reducing the use of energy and raw materials. LIFE funds projects most frequently submitted by small – and medium – sized enterprises (SME) from various industrial sectors which need assistance to overcome technical and financial obstacles to developing non-polluting technologies.

One series of LIFE projects is directly linked to the implementation of the **integrated pollution prevention and control directive (IPPC[1])**. The IPPC Directive makes provision for an authorisation system which encourages industries in the most polluting sectors to prevent or reduce pollutant emissions by complying with criteria based on **"best available techniques" (BAT)**. These techniques are described for each sector in BAT reference documents "**BREF**" *(see pages 8 and 9).*

LIFE-Environment projects operate at two levels depending on the state of progress of the BREF documents:

> **In sectors for which BREF documents have already been adopted**, projects must describe the envisaged degree of innovation in relation to techniques defined as BAT. The aim of these projects is therefore to produce substantial innovations in order to improve the BREFs.

> **In sectors where BREF documents are not yet available,** projects should provide information making it possible to determine BAT in the light of the indications contained in the Directive *(Annex IV)*.

In this way, the role of LIFE is always to make an innovative contribution to developing BAT. The most promising projects encompass a wide range of environmental aspects (integrated approach), give priority to prevention, including the prevention of waste disposal, make an innovative contribution and present a sound overall balance.

Some projects may benefit from LIFE funding in order to optimise the application of existing BAT to **specific local situations**. A condition is that the project should serve demonstration purposes and enable an extension of experience in implementing BAT in view of the wide variety of situations in the Member States and different regions.

Another type of project involves **capacity building**. This applies to LIFE-Environment projects pursued in acceding or applicant countries where, for instance, information centres for clean technologies and BAT are set up. LIFE-Third countries projects focusing on such technologies are intended to make it clear to these countries that the European experience may help them to move towards sustainable industrial development.

Well-established presence, leverage role

Of the total of about 1 200 LIFE-Environment projects implemented since 1992, some 17% relate to 20 industrial sectors out of a total of 30 covered by the IPPC Directive *(see page 6)*. Approximately 10% of all projects concern clean technologies. More than 30 are directly linked with the application of the Directive, i.e. they explicitly have to do with development of BAT.

In 2003, out of a total of 104 LIFE-Environment projects selected[2], 17 were devoted to reducing the impact of economic activities on the environments, i.e. twice as many as in 2002. Twelve of these projects were in the "clean technologies" category and five came under "reduction of greenhouse gas emission".

The place of clean technologies in LIFE projects is therefore significant. Because of its innovatory character, the search for a sound cost/benefit ratio and the wish to make the results transferable, LIFE is an appropriate tool to establish BAT, in particular through demonstration of "**emerging technologies**" *(see page 9)* that are likely to open the way for new BAT. LIFE-Environment projects are particularly significant in providing leverage as they are not simply pilot projects but are implemented prior to full-scale industrial projects.

Proof through LIFE: ten examples

The ten examples of projects presented in this brochure, nine for LIFE-Environment and one for LIFE-Third countries, illustrate this leverage role. The beneficiaries are SMEs as well as branches of large concerns in various sectors. The main results obtained in terms of protection of the environment, often also involving major savings, are as follows:

> In Belgium (p. 12), a research centre has been successful in preventing the use of sulphuric acid in the manufacture of semiconductors and reducing deionised water consumption by 90%.

> In Spain (p. 13), a manufacturer of margarine has met the challenge of excluding from its production process all chemical treatment, waste disposal and pollutant emissions.

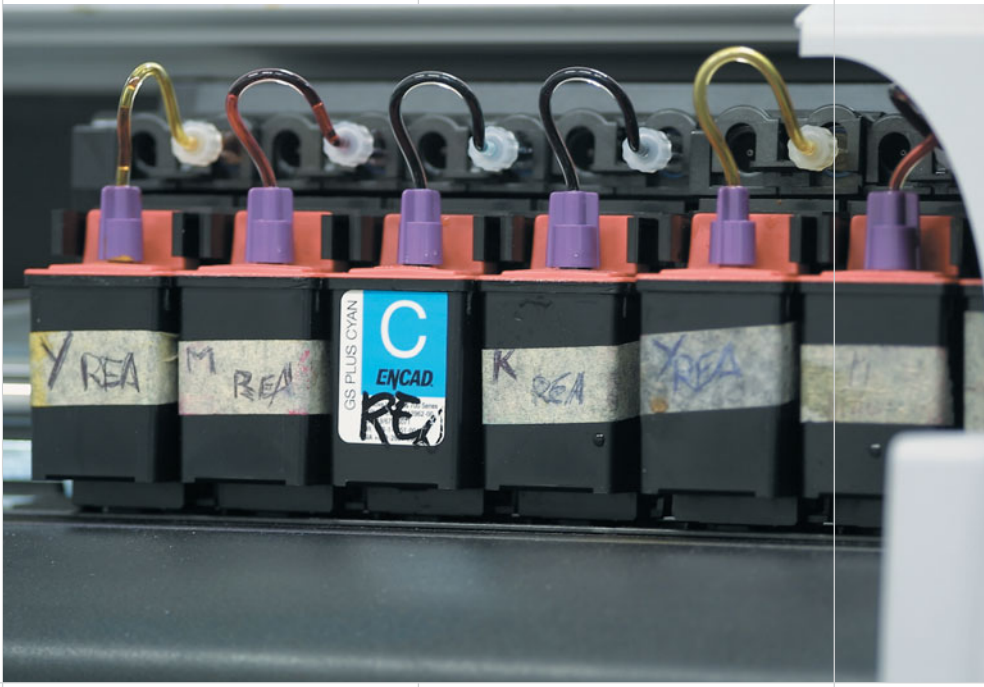
> In Italy (p. 14), a textile SME has reduced ink surpluses by 100% and waste water by 60% by developing digital fabric printing techniques at industrial level.

> In Austria (p. 15), one of the world's leading diode manufacturers has drastically reduced the level of molybdenum in residual water discharged into the Danube and has transferred the process used to a Hungarian site.

> In Germany (p. 16), an SME has introduced, with major benefits to the environment and worker health, a dry sawing technique for metal tubes and profiles which is likely to be recognised as BAT.

> In France (p. 18), a plant of a major pharmaceutical concern has considerably improved its management of water resources by developing a set of new techniques applicable to many other sectors.

> In the Netherlands (p. 20), a major manufacturer of shock absorbers and a company specialising in industrial coatings have designed a varnish which contains hardly any volatile solvents, thereby putting an end to a conflict with the local population.



Digital printing on fabric (p. 14). The aim of the IPPC Directive is to offer in each industrial sector a range of technological solutions to pollution problems.

[1] IPPC: Integrated Pollution Prevention and Control.
[2] For more information on LIFE-Environment projects of the 2003 selection, see press release IP/03/1200 of 5 September 2003 on the Europa website: http://www.europa.eu.int/rapid/

> In Italy (p. 22), the first results of an ongoing project in a refinery of a major oil company have already shown the efficacy of a process designed to greatly reduce sulphur dioxide emission by improving a BAT.

> In Russia (p. 24), a LIFE–Third countries project has enabled the adoption of a law on operating authorisations based on BAT which has already been applied to four pilot companies in St Petersburg and the surrounding region.

> In Sweden (p. 26), one of Europe's major steel manufacturers has at a lakeside steel plant developed a promising process - a future BAT? – for deacidification of waste water through electrodialysis.

Case study: LIFE in the tanning sector

Tanning involves a series of activities ranging from treating raw hides to finishing products. The main impact on the environment results from the generation of waste and waste water and the use of chemicals. As the world's leading supplier of leather, the Union comprises about 3 000 companies in this sector, mostly SMEs. The exchange of information on BAT, which are the basis for implementing the Directive (see page 9), started in 1998 and was rounded off in 2001 with the compilation of the BREF document for this sector adopted by the Commission in 2003.

Twenty-five LIFE-Environment projects, involving 21 different beneficiaries, related to activities in the tanning sector between 1993 and 2002. Their spread over 8 countries of the European Union (B, D, E, F, IT, NL, S, UK) largely reflects the distribution of these activities in the sector. In this period, the sector received virtually continuous funding from LIFE. While not all of these projects were linked with the implementation of the IPPC Directive based on BAT which the sector embarked upon only in 1998, they have nevertheless played innovative and exemplary roles with regard to clean technologies.

The total amount invested by the sector in these projects was EUR 35.5 million and the Union's contribution amounted to EUR 9.2 million, a ratio of 3.9 to 1. Without this contribution, which is not merely financial, many of these projects would not have seen the light of day or would not have attained the same level of quality.

The BAT worked out for the tanning industry in the BREF document covers five areas: management and good housekeeping, substitute chemical products, process-integrated BAT measures, effluent and water management and treatment, and waste management and treatment. For each of these areas, LIFE projects have been implemented in 1993-2002, whether or not they were linked with the IPPC Directive.

LIFE has had a genuine impact in the tanning sector:

> The 25 projects concern all the areas covered by the BAT and a wide range of Member States;

> The BREF document of the sector refers to one LIFE project (LIFE94 ENV/UK/000494: Demonstration project for the extensive introduction of clean technologies, conservation of raw materials and optimisation of production processes in the tanning industry);

> In addition to the direct impact, a much wider indirect impact is expected;

> Finally, the projects selected for 2002 and 2003 in this sector are clearly linked with the BREF document. They reflect its recommendations and seek to provide a real added value in BAT terms.

Draining dyed hides before drying.

LIFE demonstrates the relevance of emerging or insufficiently developed techniques. The picture shows the new regeneration unit of the Sanazzaro refinery (p. 22).

Findings and recommendations

On the basis of experience gained with LIFE projects, the Environment DG of the European Commission and the European IPPC Bureau *(see page 8)* have drawn up a number of findings and recommendations.

Findings:

> A large number of LIFE projects have been implemented in sectors covered by the IPPC Directive. Their direct or indirect impact on its implementation have been substantial, in particular in SMEs. LIFE stimulates exchange of information and innovative experiments and highlights the relevance of emerging technologies including those that are insufficiently developed or implemented. Several LIFE projects in various sectors are referred to in the BREF documents.

> This impact is borne out by the facts even though the role which LIFE has played is not always apparent. Some partners know and utilise the results of successful projects without necessarily linking them with the LIFE programme.

> LIFE's impact is bound to increase in the near future. Currently, the BREF documents provide guidelines for research activity and for demonstration projects which include LIFE-Environment projects. The relevant projects in the 2002 and 2003 selections are clearly linked to BREF and only those projects that are likely to improve the BREF documentation are being funded.

Recommendations:

> To secure a more systematic approach to internal exchange of information and the sharing of evaluation procedures between the IPPC Unit and DG Environment, the LIFE Unit and the European IPPC Bureau.

> Secondly, to make the dissemination of results by beneficiaries of LIFE projects more systematic. This is of crucial importance particularly in ensuring comparison, validation and recording of results in the information process on BAT. This requires that this objective should form part of the content of projects. In particular, results should be disseminated via the international sectorial press and on Internet.

> In LIFE projects use should be made of the "improving BREF documents" option, in which account is taken only of truly innovatory projects, without disregarding the "local BAT optimisation and experimentation" option. These two options are necessary and complementary to fully ensure the implementation of BAT in all countries participating in their development.

The IPPC Directive – A keystone of European environment policy

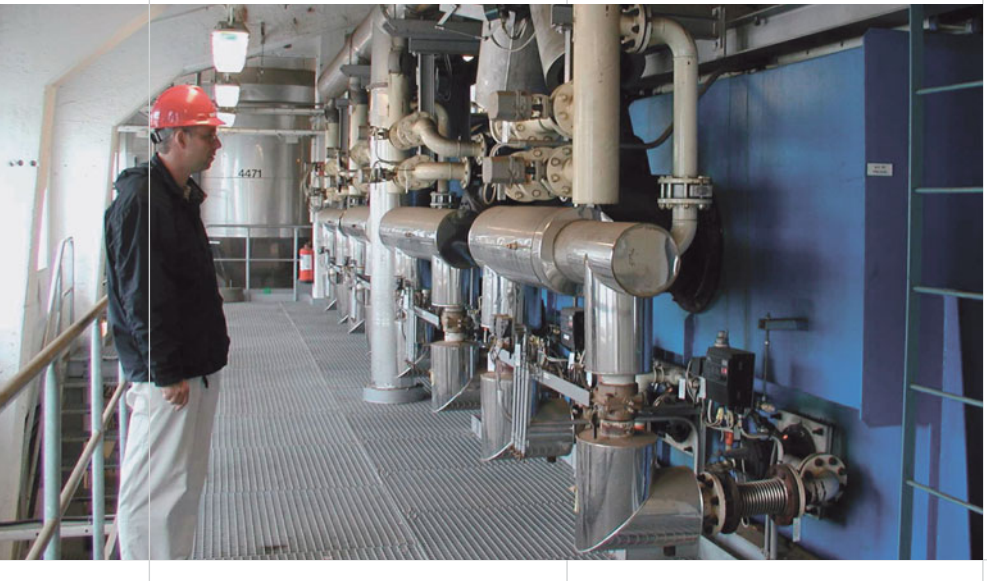
Industrial plants are among the principal sources of pollution. The Directive on integrated pollution prevention and control is therefore a keystone of the Union's environment policy. Its implementation is based on a flexible and dynamic system.

The aim of the Directive on integrated pollution prevention and control (IPPC Directive[1]) is to prevent or, if this proves impossible, reduce to a minimum: i) pollutant emissions into the air, water or the soil and ii) waste disposal and other adverse effects on the environment caused by industrial installations so as to reconcile their activities with **a high level of protection of the environment as a whole**. The operation of industrial installations is subject to authorisation which involves a full investigation of the environmental status of each of them and must be based in particular on the "**best available techniques**" (**BAT**) in the different industrial sectors.

Wide field of application

The **sectors** currently covered, listed in Annex I to the Directive, include activities with a high pollution risk such as the energy industries, production and processing of metals, mineral industry, chemical industry, pulp and paper industry pre-treatment and dyeing of textiles, tanning, slaughterhouses and food processing, treatment of animal waste, intensive rearing of poultry or pigs, surface treatment involving the use of organic solvents, and carbon or electrographite production. Annex I to the Directive also lays down from what **threshold values**, generally relating to production capacity and output, the installations in these sectors fall within the scope of the Directive.

Since October 1999, the Directive has applied to all new installations in these sectors and to installations already taken into service earlier to which changes are to be made that are likely to have an adverse effect on health and the environment. Provision is made for a transitional period up to October 2007 to bring other existing installations into line with the requirements of the Directive, given the cost of the adaptations required.



Pollution prevention mainly involves preventing the discharge of hazardous waste. In the Swedish MercOx project (LIFE99 ENV/S/000626), a process has been tried out in which mercury can be reused in the production process at a chemical plant.

… focussed on production processes

While the Directive has a wide scope, it is nevertheless limited to environmental damage caused in the **production** process *(see graph on page 9)*. In addition to recourse to clean technologies, it includes the rational use of raw materials, energy and water, disposal or recycling of unavoidable waste, accident prevention, risk management to prevent major pollution, and restoring sites after cessation of activities. However, it does not cover environmental incidents occurring at any time during a product's lifecycle, which are covered by "integrated products policy".

[1] *IPPC: Integrated Pollution Prevention and Control.*

Flexible authorisation procedure

The Directive lays down the minimum requirements for **operation authorisations**. Granting authorisation falls within the purview of the Member States or of local authorities, as the case may be. They are also responsible for laying down specific conditions for authorisation on the basis of BAT, taking account of the technical characteristics of the installation, its age, its location and local environmental conditions. Apart from particular cases the IPPC Directive does not establish any binding standards,. This decentralised approach, although carrying a risk of unequal application of the Directive, takes account of the wide diversity of situations and is conducive to "soft harmonisation" of environmental standards in European industry.

However, where necessary the Commission has the possibility of proposing "**Community emission limit values**" to the Council (minimum criteria applicable throughout the Union). On the one hand these values are fixed for emissions from installations covered by the IPPC Directive and are on the other hand based on a list of polluting substances in Annex III. To this must be added emission limit values laid down by fifteen other directives concerning the environment, listed in Annex II.

The IPPC Directive specifically deals with the following forms of environmental pollution:

- Acidification resulting from emissions into the air;
- Soil and water eutrophisation resulting from emissions to air or water;
- Diminution of oxygen in water;
- Global warming;
- Depletion of the ozone layer;
- Emission of particles into the air, especially microparticles and metals;
- Formation of photochemical ozone;
- Discharge of persistent, bio-accumulative and toxic substances into water or into the soil;
- Generation of waste, in particular hazardous waste;
- Vibrations, noise and odours;
- Over-exploitation of raw material and water resources.

Continuous exchange of information

To facilitate implementation of the Directive, the European Commission organises information exchange among the various parties involved: experts from the Member States or from acceding countries, industry, research institutes, environmental organisations, etc., coordinated by the **European IPPC Bureau** which is established in Seville (hence the reference to the "Seville process"). Working parties compile preparatory documents for each sector which are then discussed in meetings from among the stakeholders referred to above. They are also represented on an information exchange forum which supervises the process and ensures ongoing dialogue. The outcome of this exchange and in particular the compilation of BAT are published in sectorial technical reference documents, known as "**BREF**[2]" documents. The whole process is spread over a period of two to three years.

The BATs presented in these documents must then be adopted by the Commission. While the BREFs do not lay down legally binding standards, the environmental authorities of the Member States are obliged to take them into account in processing authorisation applications. To date, 15 BREF documents have been made available. All of the 30 documents are due to be published before the end of 2005. The first BREFs will be reviewed in the not too distant future. For sectors where no BREF is as yet available, the criteria to be taken into account to determine BATs are specified in Annex IV to the Directive.

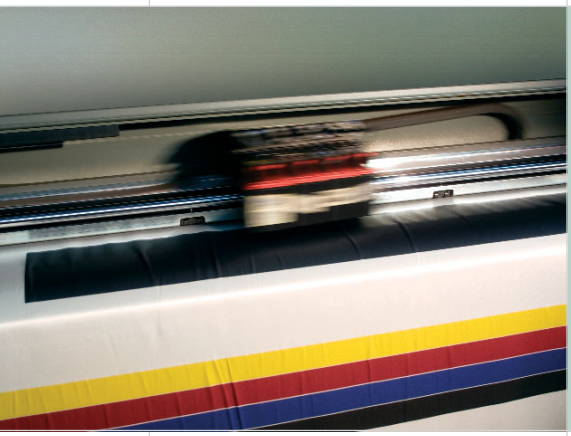
Any scheme for implementing the IPPC Directive which has the advantage of being flexible, requires responsible participation by all concerned and transparency of the process. The Directive makes provision for public access to authorisation applications, authorisations, monitoring reports and the **European Pollutant Emission Register** (**EPER**[3]) published by the Commission. The Commission has also set up the **European Union Network for the Implementation and Enforcement of Environmental Law** (**IMPEL**[4]), an informal network which brings together the competent authorities of the Member States and the acceding countries.

[2] BREF: BAT (best available techniques) Reference document
[3] EPER: European Pollutant Emission Register.
[4] IMPEL: Implementation and Enforcement of Environmental Law

European legislation and IPPC Directive: the context in brief

When the **IPPC Directive**[1] came into force in October 1996 it already reflected the wish, reaffirmed in the **Sixth environment action programme of the European Community**[2], to lay greater emphasis on prevention in environmental protection and to move towards sustainable development. It obviously interacts with other legislation and policies concerning the environment, as indicated in the list of 15 directives included in Annex II. The Commission strives for an optimum combination of environmental policy instruments, including the LIFE programme. Moreover, two-way links are established between the BATs developed under the IPPC Directive and R&D action undertaken under the **Sixth Framework Programme for Research, Technological Development and Demonstration**[3].

[1] Council Directive 96/61/EC of 24 September 1996.
[2] Decision 1600/2002/EC of the European Parliament and of the Council of 22 July 2002.
[3] Decision 1513/2002/EC of the European Parliament and of the Council of 27 June 2002.



For more information and for contact:

IPPC Directive (text, information, links, e-mail, EPER register):
http://www.europa.eu.int/comm/environment/ippc/index.htm

Commission Communication: http://europa.eu.int/eur-lex/en/com/cnc/2003/com2003_0354en01.pdf
and press release: http://www.europa.eu.int/rapid

Consultation campaign:
http://www.europa.eu.int/comm/environment/ippc/ippc_consultation.htm

European IPPC Bureau and access to BREF documents: http://eippcb.jrc.es
and e-mail: eippcb@jrc.es

IMPEL network: http://www.europa.eu.int/comm/environment/impel

Which "best available techniques"?

- **Best:** the most efficient ones to attain a high general level of protecting the environment as a whole;
- **Available**: established on a scale enabling their widespread application within a given sector, under conditions which are sustainable from a technical and economic point of view in terms of costs and benefits and ensuring reasonable access for operators in any Member State;
- **Techniques**: this includes production techniques and the way in which installations are designed, constructed, maintained, operated and closed down.

The choice of BAT may **vary** from one installation to another in that the specific situations, costs and benefits are variable. BATs are those techniques that make it possible to **reconcile** industrial production and environmental protection, particularly if they can be operated with economic and strategic benefits to the companies concerned. Particular techniques which are superior from an environmental angle but deemed to be too costly for a sector as a whole may not meet the BAT defining criteria.

As technologies, industrial context and environmental requirements are constantly changing, the concept of BAT is essentially **dynamic**; the implementing conditions of the IPPC Directive are sufficiently flexible to enable authorities and operators to make appropriate choices within a sound cost/benefit ratio.

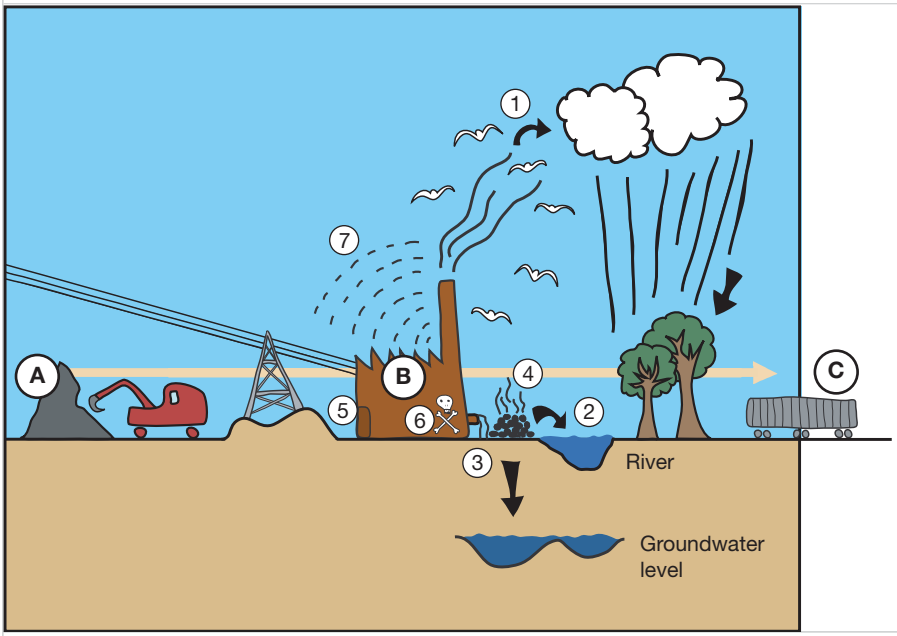
What do "BREF" documents contain?

Each BREF document is dedicated to the overall and integrated approach within an industrial sector. They are extensive documents containing the following chapters:

- Preface (legislative context, sources of information, how the document should be used) and executive summary;
- General information about the sector;
- Brief description of current processes and techniques within the sector;
- Data on recent levels of polluting emissions and on raw material, energy and water consumption in the sector;
- Inventory of techniques taken into account in selecting BAT in the sector;
- Presentation, with proper justification, of the techniques considered to be the **best available techniques**;
- Information on **emerging techniques** concerning the sector, i.e. innovative technologies for preventing and reducing pollution currently in the experimental stage;
- Conclusions concerning particularly the quality of information exchange, the level of consensus attained and recommendations for follow-up including the need for research, development and demonstration.

Scope of the IPPC Directive

Integrated approach to all environmental aspects of the production process



A - Raw materials and energy
B - Industry in a particular sector
C - Life cycle of products and external recycling of wastes (not covered by IPPC Directive)

1 - Emission to air
2 - Emission to water
3 - Emission to soil
Liquid effluents and solid waste
4 - Prevention and recovery of waste and waste water
5 - Energy efficiency and choice of raw materials
6 - Accident prevention and control
7 - Noise, vibration, heat, odour.

"Every project is important and significant"

LIFE and the challenges of the IPPC Directive

Mr Don Litten heads the European IPPC Bureau in Seville which coordinates exchange of information to determine the "best available techniques" (BAT).

Mr Litten, as the Commission's recent Communication[1] shows, implementing the IPPC Directive is a complex task. What are the weak points and how can LIFE help to overcome them?

> *Rather than talking of weaknesses, I would say that the Directive presents a major administrative challenge to the Member States as it is based on an integrated approach which must be applied in a wide range of sectors. The Directive makes it necessary to take account in a coordinated manner of all questions regarding the environment which have historically been responsibilities shared between local, regional and national authorities, which poses a political difficulty. However, this cannot be overcome through blanket European programmes because of specific national realities.*

An important problem relates to the application of the "threshold criteria" laid down in the list of activities (Annex 1) covered by the Directive. For instance, what are the threshold criteria for finished products in the tanning sector? If one talks of 12 tonnes of finished products, does this refer to any product produced by a tanning plant, which may be part-processed leather intended for subsequent treatment elsewhere (but which is "finished" as far as the first site is concerned), or a dry product ("finished" in that it is ready for use in a shoe or furniture factory, for instance)?

There is a wide scope for potential research on the application of various thresholds in the real life of industries and this is where LIFE can play an experimental role, as this brochure shows. The question is also how to change the thresholds in cases where, for example, a threshold proves to be a source of competitive disadvantages. The threshold has been determined to reflect to a certain degree the pollutant potential of an installation and this means it covers some SMEs. However, the Directive does not cover all European industries and even for those it does cover it applies to existing industries in the framework of national plans for implementation: it provides that all existing installations must be in conformity with its provisions not later than by October 2007. The exact timetable depends on the political decision of each Member State.

As for the question whether a technique meets the definition of "best available techniques" (BAT), evidence is needed that it is technically and economically viable in the sector concerned. In the cement industry, for instance, there has been a debate on the viability of reducing the level of nitrogen oxide (NOx) for BAT purposes.

In this instance, a pilot project had produced promising results in selective catalytic reduction. Such results may stimulate the application of a technique on a wider scale to prove, for instance, the viability of catalytic converters at full-scale operation. An equally important criterion is the ability of write-off of environmental investment. If you invest in clean technology with an expected return over five years and it is superseded after two years by cleaner technology, changing over to the new technology is then a very costly exercise.

What can LIFE do in areas where there are as yet no BREF documents? Do you think that LIFE should support projects whose innovative character consists above all in trying out local formulae for implementing the Directive?

> *Work on revising the first BREFs will start shortly. The Commission's Research Directorate-General specifically intends to indicate in several BREFs the known areas in which information is poor and inadequate, and the LIFE projects likely to provide new information that may be taken into consideration.*

Over and above purely technological aspects, LIFE may certainly play a key role in encouraging collaboration among public authorities, industry and NGOs. Relations between industry and the authorities generally consist of negotiations and may even by polemical. If within a pilot project a commitment is made to exchange information, to establish a partnership, this creates the possibility of working together and understanding the other's point of view.

What ways are there to improve the process of validating BAT linked with LIFE projects, their incorporation in BREF and the visibility of this link?

> *In cases in which industry itself engages in R&D, it often happens that no detailed information is disseminated for public use. In such cases, it is very difficult to claim validation of promising environmental performance. LIFE can provide a clear and transparent information flow between each project and our work on BAT. To date, particular questions such as the use of energy have not often been dealt with in such a way that the data can be extrapolated from one company or one installation to another. A LIFE project may include an information exercise geared to such questions which may prove to be of considerable interest to us and others.*

What do you think of the link between LIFE and research and development (R&D)?

> *It is excellent. Where industry undertakes R&D activities, it too often keeps the results secret in order to retain control over applications. LIFE, on the other hand, is a public programme and as such must make results available and open up the debate.*

The IPPC Directive mainly concerns large companies. Do you think that LIFE has a role to play vis-à-vis SMEs?

> *I do. Industry is structured at various levels and, for example, a large concern like Solvay has its own research department, as it has the means to fund it. On the other hand, SMEs have neither sufficient resources for research nor easy access to information. Hence the importance of programmes encouraging exchange of information. One aim of LIFE is to foster research applications for SMEs in order to enhance their knowledge capital.*

The 104 LIFE-Environment projects selected in 2003 include 12 clean technology projects and five greenhouse gas reduction projects. Do you consider these figures significant?

> *One single project would be significant! Each project is important and significant. Any information made public in the field of R&D is significant. When research results are made public, industry faces the challenge to respond, communicate and compare technologies.*

What are your views on a "more harmonised approach" conducive to fixing "emission limit values" at Community level?

> *The Directive makes clear provision (Article 18) for the possibility of setting Community limit values. I believe that if this approach were adopted throughout, the Member States would not be prepared to accept the most ambitious performances and this would lead to negotiations eventually producing the lowest common denominator. The idea behind the BAT approach is to be able to find solutions geared to specific cases and circumstances. It is necessary to take account of actual conditions, in particular geographic realities. To give an example concerning slaughterhouses: pigs raised in Italy weigh twice as much as in the Netherlands or Denmark. An installation currently in use in the Netherlands would not support the weight of Italian pigs. Another example: in Sweden or Finland, the temperature may drop to –50°C and in the south of Spain it may rise to +50°: how can one hope to establish the same processes with the same energy efficiency? Apart from the variety of situations obtaining in each country, account should also be taken of the distinctive features of products which have their roots in traditions and regions: a Rioja is a Rioja, a Palermo is a Palermo.*

What do you think of the situation in the future Member States?

> *With regard to the IPPC Directive, it would be wrong to believe that these countries are special cases. For every current Member State, its implementation is a challenge, the BAT are a challenge, and this challenge is connected with the complexity of processes in each country. Accordingly, the new Member States will not be at a disadvantage and LIFE should be accessible to them according to the same criteria as for the other countries.*

[1] *http://europa.eu.int/eur-lex/en/com/cnc/2003/com2003_0354en01.pdf*

LIFE-Environment project in Belgium

Semiconductor industry: innovation moves ahead

By avoiding the use of sulphuric acid in the manufacture of semiconductors, the process worked out by a research centre with LIFE funding spares the environment while ensuring substantial savings for industry.

© IMEC

From the lab to industry – the contribution of a LIFE project to clean technologies.

About 30% of the operations involved in manufacturing semiconductors consists of cleaning silicon wafers by means of large quantities of aggressive chemical solutions such as sulphuric acid. This is harmful to the environment, to which must be added the high costs involved, in particular because of the considerable quantities of de-ionised water (**DI**) needed. One of the main applications of the process is photoresist stripping. The Interuniversity Microelectronics Center (IMEC), a Flemish association which has become one of the world's leading independent microelectronics research centres, has developed an original alternative to photoresist stripping in partnership with a private German company of the Texas Instruments group.

The new technique combines the use of ozone (O_3) with a DI boundary layer controlled process at the wafer surface. Its superiority over the conventional O3/DI technique is due to a stronger concentration of reactive ozone near the surface. The IMEC process avoids the use of sulphuric acid and reduces de-ionised water consumption by 90%. For a medium-sized company, this is tantamount to savings of 2 200 litres of sulphuric acid and 500 000 litres of DI water a week.

The possible integration of the requisite hardware in existing equipment, moreover, limits the investment required.

The process has initially been incorporated in IMEC's semi-industrial production line before moving on to full-scale integrated circuit production units of Texas Instruments in Freising (Germany). The many changes made to the conventional system include the installation of an ozone generator. Because of the safety problem of releasing a large quantity of this gas into the air, initial experiments were carried out with an ozone-destroying catalyst conversion system, which has in the meantime been replaced by a thermal system operating at 90% efficiency. Experimenting with such systems under conditions of high steam concentrations in the exhaust circuit has been a "first" in this domain. Moreover, a secured ozone detector ensures protection of workers.

While the project could not be completed within the LIFE framework because of technical restructuring at Texas Instruments, the results are more than promising. The new process, which is attractive and transferable, has a promising future in Europe's integrated circuit industry.

Reference: LIFE99 ENV/B/000649
Eligible total cost: EUR 1 571 753.03
LIFE contribution: EUR 675 509.11
Beneficiary: IMEC, Kapeldreef 75, B-3001 Leuven

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Duration: from 1 February 1999 to 1 February 2001

LIFE-Environment project in Spain

Ecology and margarine: they are compatible

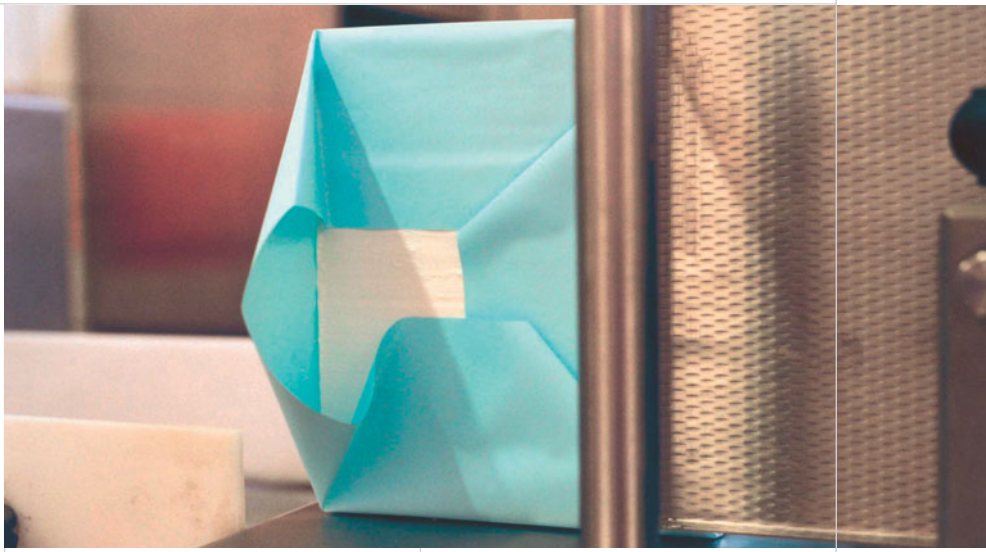
Producing margarine by using only clean technology without any polluting waste and still remaining economically viable? It's possible, as this LIFE project has shown.

Manufacturing margarine normally generates considerable amounts of polluting waste. Refining fats by means of sodium hydroxide leads to the formation of sodium soap which has to be eliminated by rinsing and through treatment with chlorohydric acid. This leads to large quantities of highly polluting waste water which has to be purified. The hardening of oils and fats through hydrogenation involves hydrogen emission into the air. Emulsifiers and other chemical additives complete this brief overview.

Lasem Alimentación[1] used to apply these processes themselves until they decided to switch to sustainable growth and to develop a line of ecological products. They received LIFE funding for their project to produce ecological margarine manufactured with raw materials which were likewise ecological, using only clean technology without any chemical treatment and without generating any solid or liquid waste or pollutant emission.

Fats are refined in a physical process under vacuum at high temperature. After mixing, natural colouring and flavouring agents are added and the mixture is emulsified with water. The emulsion is then subjected to crystallisation and crystal maturation and stabilisation, followed by plastification (high-pressure cooling). Hydrogenation and a number of other stages are eliminated. The new equipment used wards off risks of contamination and facilitates cleaning.

The raw materials used are coconut fat from coconut palms abundantly growing in the wild in the Philippines. One difficulty is to secure a regular supply of a product from untreated trees, extracted without solvents. Another raw material is sunflower oil which is available in Spain where the plants are cultivated without chemical treatment.



Packing, the last stage of a wholly ecological manufacturing process.

In spite of the higher cost of the raw materials, the process consumes less energy and obviates the need for high expenditure on water purification and sludge treatment. It benefits from sound opportunities on a market which is increasingly open to ecological products. Highly innovative, this LIFE project also applies strategic planning which may be of interest to other agrifood producers and other industrial sectors.

[1] After the LIFE project, Lasem Alimentación was taken over by Vandemoortele Iberica. For legal reasons connected with questions of real estate, the Lasem site has been closed down and the production of ecological margarine in accordance with the techniques developed with LIFE funding has been relocated to an existing site in Belgium.

Reference: LIFE98 ENV/E/000366
Eligible total cost: EUR 1 550 793.06
LIFE contribution: EUR 214 679.13
Beneficiary: Lasem Alimentación (Vandemoortele Iberica), Frederic Monpou, 5, 1°4a, E-08960 Sant Just Desvern

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Duration: from 1 April 1998 to 1 July 2000

LIFE-Environment project in Italy

Cleaner digital printing in the textile industry

This LIFE project supported the development of the innovative, economical and low-polluting technology of digital printing on fabric which is likely to lead to a breakthrough in the textile sector with positive socio-economic effects.

Modernity in traditional colours.

In the Italian province of Como, printing on silk is a centuries-old tradition. However, it has inevitably had an impact on the environment, with large quantities of waste colouring agents and rinsing water, high energy consumption for drying, and noise. The LIFE Tieprint project arose from the idea of combining this tradition and modern digital printing techniques to reduce these drawbacks and the costs involved. For this purpose, an SME, Stamperia di Lipomo, formed a partnership with other local companies and with the Associazione Impresa Politecnico, which is specialised in management of new technology.

Digital printing on fabric had been regarded as applicable only to small samples and had not moved beyond the experimental stage. With this LIFE project, the aim was to work out an innovative technique which could ensure regular production in a varied range of fabrics, responding to the growing interest in the textile sector among computer equipment manufacturers and software producers.

After taking stock of the activities, costs and resources of the three companies, benchmarking digital ink jet printing techniques and trials with the model chosen (ENCAD/SOPHIS), the next step was to improve performance. For instance, the use of a spectrophotometer makes it possible to determine parameters on the basis of a fabric sample submitted by a customer and then print in the same colours, with savings in time, dye and energy.

The results are highly illustrative: dye savings because of a 100% reduction in excess dyestuff, 60% reduction of waste water, 80% savings of thermal energy and 30% savings of electricity, 60% noise reduction and 60% reduction of production space required, and an overall reduction of costs. In addition to these benefits for the environment, there has been a major improvement in working conditions, with positive socio-economic effects. A challenge for the future is to ensure continuity of this activity and success in marketing the products.

Reference: LIFE99 ENV/IT/000122
Eligible total cost: EUR 1 415 091. 90
LIFE contribution: EUR 368 130.48
Beneficiary: Stamperia Lipomo SpA, Via Statale per Lecco, 7, IT-22030 Lipomo

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Duration: from 20 November 1999 to 20 March 2002

LIFE-Environment project in Austria

Manufacture of diodes: less molybdenum along the Danube

The Vöcklabruck site owes its competitive position to its advanced technology and the quality of its products but nowadays also to a high level of protection of the river environment: a new process introduced under this LIFE project has made it possible to almost completely eliminate pollution of residual waters.

At its ultramodern Vöcklabruck site, one of the major production units in terms of volume and quality, the Vishay Semiconductor Austria company, which forms part of the Vishay Intertechnology Inc. group, manufactures about 200 million diodes a year. The diodes are used as fast rectifiers in a wide range of applications in the electronics industry, e.g. in switching circuits, fluorescent tubes, computers, monitors and TV sets and as electronic components in cars.

Production of the diodes involves the use of sintered molybdenum (**Mo**) pins. Before being used in the production process, the oxide film has to be removed from these pins. In the past, they had to be etched with nitric, sulphuric and hydrochloric acid for this purpose and then rinsed with water. The result was a very high concentration of Mo in the waste water discharged into the Vöckla river which eventually flowed into the Danube.

Both because of its desire to protect the environment and on account of new environmental legislation in Austria, Vishay has with LIFE funding developed a project based on the industrial application of an entirely new technology to remove the oxide film through a mechanical process, barrel polishing, which acts through friction. A new soldering technique to assemble components has been introduced and a new soldering oven with a high precision control system has been installed.

Loading carbon forms into the prototype oven (3 000 diodes per mould).

The result of the LIFE project has been a drastic reduction of molybdenum in waste water: 0.6 mg/l instead of 18 mg/l at full production capacity. The residual rate is due to the fact that a brief leeching stage is still necessary in producing the pins. In addition to this remarkable result, which also benefits other countries along the Danube, there have been substantial reductions in costs: lower cost of waste water treatment, less acid used and fewer diode rejects. The new process is easily transferable, and a second diode production line has been established at another Vishay production site, in Gyöngyös (Hungary).

Left: chemical treatment of molybdenum pins. The LIFE project was launched to work out an alternative to this process.

Reference: LIFE99 ENV/A/000391
Eligible total cost: EUR 400 085.90
LIFE contribution: EUR 118 973.53
Beneficiary: Vishay Semiconductor Austria Ges.m.b.H, Telefunkenstraße 5, A-4840 Vöcklabruck

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Duration: from 1 September 1999 to 30 November 2002

LIFE-Environment project in Germany

High-speed cutting without cooling for cleaner metalworking: cutting-edge technology

A technique for cutting tubes and profiles that avoids environmental problems and safeguards workers' health: the Dry Tech process, developed by an SME with LIFE funding, is about to conquer the market and establish a standard.

A cutting technique which gives off sparks on the metal tubes and profiles market.

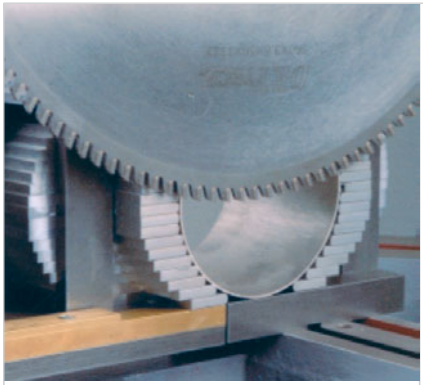
In the metalworking industry, virtually all cutting operations currently require the use of cooling lubricants. By reducing the friction heat between the cutter and the workpiece, the lubricants minimise tool wear.

In spite of the technological benefits, the use of these lubricants poses major problems. After use the lubricants have to be recovered from the machines before other operations can be started, and they cannot be disposed of without prior treatment. The use of lubricants involves costs of checks, maintenance, recovery, transport, energy, etc. Leakage from the product, rinsing of the equipment and disposal of offcuts contaminated with the lubricant cause air, water and soil pollution. There are also hazards for the health of workers: skin irritations, eczema, respiratory problems and of course the risk of chemical accidents and accidents due to the many operations required in the process.

At ITEC GmbH, a well known SME specialised in the manufacture of circular saws, this new idea was inspired by experience gained in the use in the building trade of portable carbide-tipped circular saws. Why not emulate this technique in industry? With LIFE funding, this led to a project in which a high-speed Dry Tech circular saw was developed which requires no cooling lubricant.

Dry cutting technology is based on the extreme thinness of the saw blade combined with load-dependent feed regulation. In comparison with conventional saws, Dry Tech saws require less energy leading to less energy converted into heat. Cutting speeds are very high, from 1 000 to 1 500 m/min, increasing output by 65% and reducing burr and noise. Equipment costs are reduced because blades can be ground up to five times. The whole process leaves no lubricant residues, producing savings on various items of expenditure and in terms of operating time. Additionally, there is an inestimable benefit in terms of human health, working conditions and conservation of the environment.

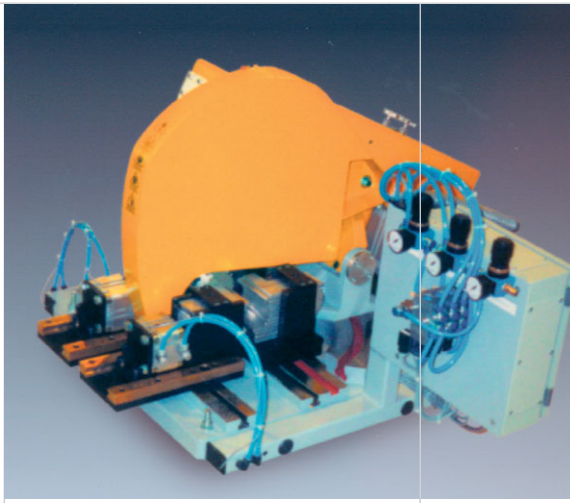
The Dry Tech saw is mainly applied to thin-section metalworking such as the manufacture of tubes and profiles in various materials, ventilation and air-conditioning equipment and car components. The useful life of the blades, comparable to or exceeding that of



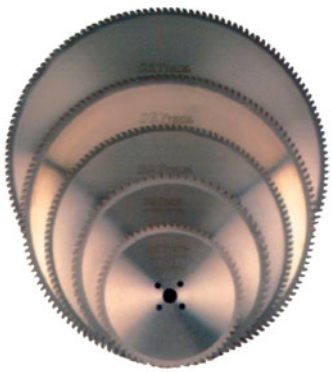
conventional saws, is shorter for high-grade non-corroding steel for which the new technique is competitive only in particular areas such as the food industry, requiring further development.

On the basis of an overall design worked out by ITEC, the new process has been intensively tested to check its technical and environmental performance and its economic viability before moving on to pre-mass production. The tools are adapted to the needs of all potential users and companies of all sizes, from small workshops to large industrial plants. Three series of models are produced: manual, semi-automatic and fully automatic. The marketing of the machines has been launched and they appear to be doing well, given the very promising results of trials and the growing interest in this technology.

There is no doubt that high-speed dry cutting is a promising technology for the tube and profile manufacturing industry for which it is likely to recognised as the "best available technique". In more general terms, it is a step towards the development of environmentally friendly cutting techniques. In addition to implementing the IPPC Directive, the LIFE project has contributed to implementing European legislation on hazardous waste, volatile organic components and worker



No chemical fumes, fewer manipulations: the Dry Tech cutters spare workers' health and safety.



Reference: LIFE99 ENV/D/000435
Eligible total cost: EUR 400 085.90
LIFE contribution: EUR 118 973.53
Beneficiary: ITEC GmbH, Ernst-Abbe Str. 5, D-52249 Eschweiler

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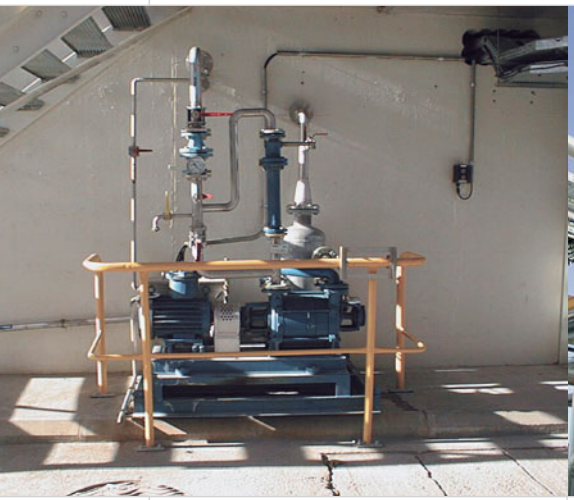
Duration: from 1 January 1999 to 1 January 2003

LIFE-Environment project in France

The pharmaceutical industry looks after the environment

The innovative techniques applied at the Aramon plant through this LIFE project have led to a drastic reduction in water consumption and a major improvement of the quality of treated water. They are applicable to various sectors.



Left: new non-polluting and more efficient "dry" vacuum pumps.

Right: cooling tower and hot water recycling.

The SANOFI-SYNTHELABO company, which forms part of one of the world's leading pharmaceutical concerns, produces active pharmaceutical ingredients at its Aramon site. In 1997 it started increasing its capacity while setting up installations protecting the environment and improving its overall use of water resources. To achieve this with account being taken of the pollution caused by the plant, use had to be made of various innovative technologies. The project, co-financed by LIFE, comprised four main components:

1. Building the new NEPTUNE *water treatment* plant which uses state-of-the-art membrane bioreactor (**MBR**) technology, in partnership with the specialised Degremont company. MBR combines biological treatment with membrane filtration. It reduces pollution due to suspended matters (**SM**), total Kjeldahl nitrogen (**TKN**) and chemical oxygen demand (**COD**). The Aramon MBR occupies a leading position because of its limitation of waste discharge and the treated organic load.

Upon completion of the project, the volume of water treated had doubled from 450 to 900m3 a day. COD input may be as much as 11 000 mg/l while output is reduced to 400 instead of 450 mg/l. SM discharge has dropped from 205 to 8 mg/l and that of TKN has been reduced by 75%. The quantity of excess sludge diminished from 3 000 to 1 000 tonnes a year. The improvements have brought about better treated water quality, operational flexibility to deal with a variable pollutant load, and enhanced reliability. However, MBR requires careful prior filtration to protect the membranes, resulting in a 15 to 20% increase in electricity consumption. Overall, however, the LIFE project has demonstrated the high output, economic viability and transferability of MBR, which has in the meantime also been introduced in other sectors: cosmetics industry, paper manufacturing, agrifood sector, waste treatment and urban water treatment.

2. *Recycling of heated process waters* in a closed-loop refrigeration system with a pool for waste water discharged by existing workshops (70% of plant discharge). The water is kept at a constant temperature of 18°C with the aid of heat exchanges: cooling towers in winter, refrigerant units in summer. This system, called PEGASE, uses technology that is already applied on a large scale but never before in existing buildings. From the outset, it led to 50% (3 000 m3) daily savings in water. Another system, based on monofluid *(see below)* in a closed watertight circuit, i.e. without a pool as a source of bacterial proliferation, was subsequently installed in new workshops for all cooling/heating operations.
3. The introduction of two new clean technologies. The first, *using "dry" vacuum pumps* (with no oil added), offers various advantages: these pumps do not consume water except for cooling, do not pollute, do not corrode, have low servicing costs and a longer life, and make it possible to attain a vacuum that is lower

New biologic basins at the Aramon site.

The bioreactor membranes.

(< 1 mbar) and more stable for chemical reactions. As the project has demonstrated, their superiority for controlling reactions compensates for their high extra cost. They are intended in particular for use in chemical industry, heavy industry and the oil industry.

The second of these technologies uses a *coolant monofluid* based on monoethylene glycol. Distributed by three closed loops, it is maintained in each of these at constant temperature with the aid of control valves in accordance with the temperature range appropriate for each type of chemical reaction inside reactors during synthesis operations (ranging from –25 to +130°C). This process, which replaces the use of three different fluids, removes the risks of mixing and corrosion and virtually eliminates glycol leaks. Twice as powerful as PEGASE, the process uses up hardly any more energy and its operating costs are lower, which offsets investment costs. The process also enables better control. While the monofluid can virtually be used only in new installations, it is tantamount to a revolution for many industries in sectors such as the chemical, microelectronics and agri-food industries.

4. A study of the *re-use of water treated* by the inverse osmosis process concluded that its costs/benefit ratio would not be worthwhile except possibly in regions with very limited or precarious water resources. However, the idea of such re-use has not been given up but its realisation is outside the scope of the LIFE project.

Overall, the project has made it possible to drastically reduce water consumption: 1 440 000 m^3 a year instead of 2 490 000, in spite of increased production. The technologies have since then been transferred to another SANOFI site in Sisteron and are due to be applied also to the company's other sites worldwide.

The NEPTUNE treatment plant under construction.

Reference: LIFE97 ENV/F/000176
Eligible total cost: EUR 6 575 911.22
LIFE contribution: EUR 789 949.11
Beneficiary: SANOFI Chimie, Usine d'Aramon, Route d'Avignon, F-30390 Aramon

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Duration: from 17 February 1997 to 17 August 1999

LIFE-Environment project in the Netherlands

Industrial paint for shock absorbers: environmental impact largely absorbed

Zero emission of volatile solvents: this was the objective and, falling only 1% short, it has been achieved in this LIFE project which has opened the way for eliminating these substances from industrial paints. At the same time, local residents can at last breathe cleaner air without any unpleasant odours.

The village of Oud-Beijerland is the headquarters of the Koni company, one of the world's leading manufacturers of shock absorbers: 1.5 million shock absorbers a year for cars – including formula 1 racing cars – trains and lorries. The production unit is located on an industrial estate around which an increasing number of houses have been built. To protect the shock absorbers against corrosion and at the same time improve their appearance, they are coated in a spray painting line. The paint formerly used contained up to 85% solvents which emit volatile organic compounds (**VOC**) such as hydrocarbons into the air.

VOCs contain carcinogenic, mutagenic or toxic substances. Moreover, they trigger the formation of ozone whose excessive concentration at ground level is hazardous to human health. An additional nuisance at production sites such as Koni's is unpleasant odours about which people living in the surrounding area have lodged frequent complaints. Various measures taken in the past to overcome this problem proved ineffective.

Reducing the use of VOCs in industry is one of the main challenges facing Europe's environment policy[1]. In order to comply with this obligation while at the same time meeting the concern of local residents, and simultaneously gain a comparative advantage, Koni decided in 1998 to invest in a wholly innovative approach.

After various possible options had been judged unsatisfactory because of the specific technical requirements of painting shock absorbers, it was decided to develop a tri-component epoxy paint based on water rather than solvents which met the highly specific needs of the metal industry and was compatible with modern spray-painting equipment. The objective pursued by Koni was to immediately improve the environmental performance of its paint shops: 100% reduction of VOC emission and 50% reduction of other chemical substances. At the same time, Koni sought to substantially improve working conditions and, of course, eliminate offensive odours.

To achieve this ambitious project, Koni entered into partnership with the Dutch Hasco Lakfabrieken company which specialises in coatings for industrial applications. The project was granted support by LIFE-Environment in view of the quality of the dossier, the importance of the objective at European level and because of the fact that this was the first application of a water-based tri-component paint to surface treatment in the metal industry.

After various unsatisfactory trials, Hasco had to develop an entirely new product which with truly minimal (1%) VOC content almost entirely meets the requirement. The three components are the base paint, the mixing paint and water. The distinctive feature is the unconventional ratio of ingredients in the first two components. In Hasco's base paint the pigment is combined with the hardener and not with the resin. In the mixing paint, epoxy resin is the main component. As the mixing paint is not water soluble, a good mix of the first two components is indispensable.

The use of the product has made it necessary to rearrange the workshops and build a new installation. At the end of 2002, the new process was ready to go ahead. The shock absorbers are conveyed in a 420m chain along the full length of the spray-painting line. After various pre-treatment stages, the paint is vaporised by a fast-rotating vertical disc at 7 000 to 10 000 rpm. The shock absorbers form an omega (Ω) loop around the disc and also turn around their own axis. Manual painting units are provided for areas with difficult access and for small batches.

This is followed by rinsing and evaporation, between 20 and 50°C. At the end of the line, an 80° oven ensures rapid hardening of the paint.

However, there have been a few technical hitches. When the chain was first started up, the viscosity of the paint triggered unexpected pressure which caused the pipes to explode. This problem was solved by fitting more resistant pipes and changing the type of pumps used. Moreover, the 1% glycolated water used for rinsing proved ineffective and was replaced by demineralised water at 40°C. It took three months before the system was finally operational.

The LIFE project, whose results have been widely disseminated, undoubtedly opens the way to eliminating VOCs from industrial painting processes in Europe. It has also prevented the relocation of the site which was under consideration because of the olfactory hazards to the local population. In fact the number of complaints from local residents has diminished by 100%.

Shock absorbers undergo a series of operations along the full length of a 420 m line.

[1] *Council Directive 1999/13/EC of 11 March 1999.*

The new water-based industrial paint embellishes without polluting (left: paint container).

Reference: LIFE00 ENV/NL/000794
Total eligible cost: EUR 1 974 731
LIFE contribution: EUR 354 185
Beneficiary: Koni BV, Langeweg 1, PO Box 1014, NL-3260 AA Oud-Beijerland

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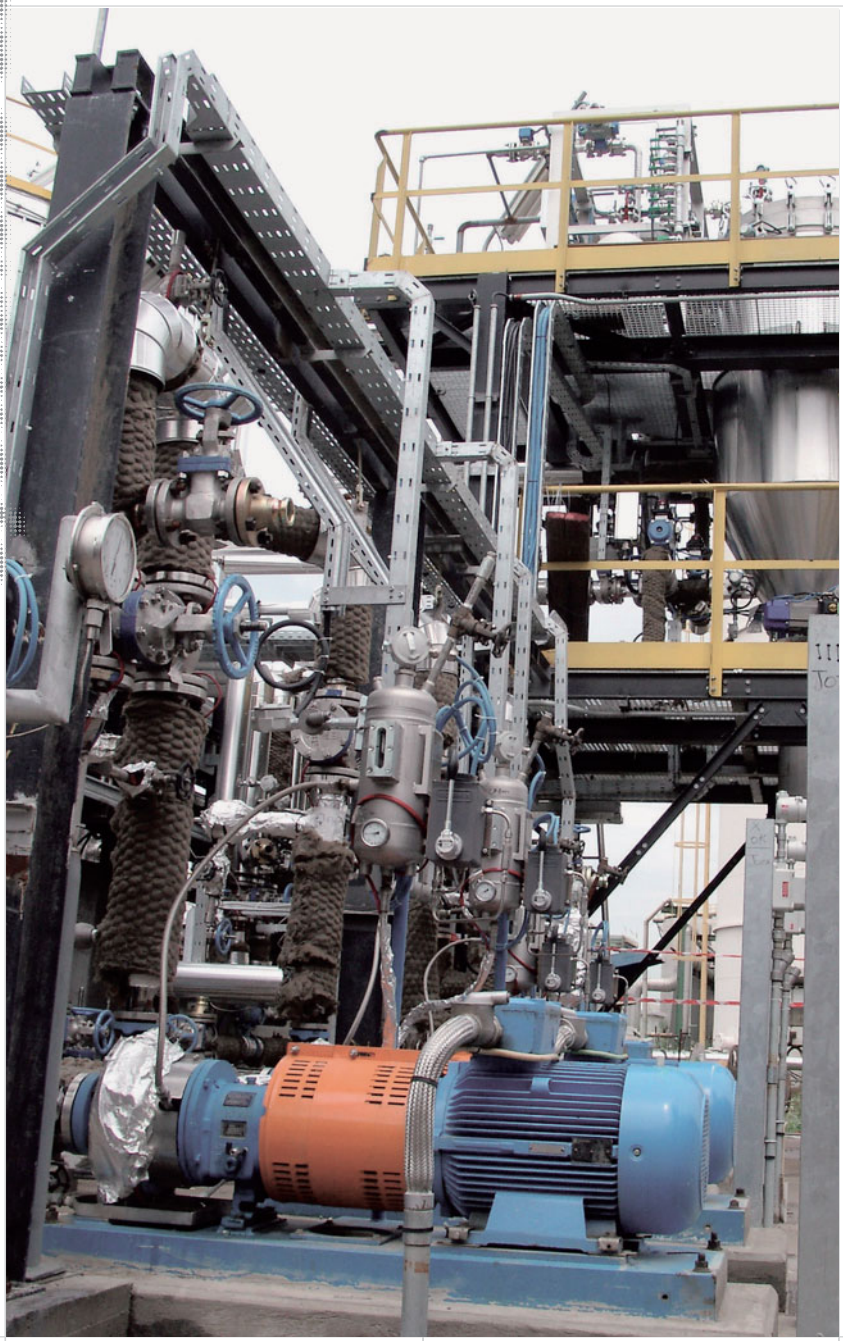
Duration: from 1 July 2001 to 1 July 2003

LIFE-Environment project in Italy

An oil industry that smells less of sulphur

The LIFE REFINARS project, currently in progress, is intended to demonstrate the applicability of a highly innovative technology to many oil refineries. The challenge is formidable: reducing emissions of the notorious sulphur dioxide. Testimony from Andrea Amoroso who is responsible for the project.



"The Sanazzaro refinery in the Po valley forms part of the Refining & Marketing division of ENI SpA (formerly Agip Petroli). With a production capacity of 160 000 barrels a day, it is one of the most modern refineries in Europe. It uses the highly advanced fluid catalytic cracking (**FCC**) process which converts the heavy products from the first distillation of oil into high-grade light products. Currently, however, application of the FCC process has adverse effects on the environment. In order to contribute to reducing these effects, the LIFE REFINARS project was launched in Sanazzaro; it is due to be completed in September 2004.

"In the FCC process, carbon deposits are formed at the catalyser surface. Its regeneration for re-use requires burning the residue. As the carbon deposit contains sulphur, burning it converts it into sulphur dioxide (**SO_2**) which is emitted together with the flue gas. The SO2 is a powerful pollutant and one of the main causes of air pollution and acid rain affecting ecosystems, biodiversity, forest growth, agriculture and human health.

"The overall objective of REFINARS is to demonstrate the applicability and improve the performance of a "best available technique" (**BAT**). By this it is intended to desulphurise flue gas through a patented system (Belco/Labsorb) based on a solution containing an absorbing agent with which the sulphur can be recovered for re-utilisation.

"The project involves various objectives: reducing sulphur oxide (**SO**x) emission by about one-third of the legal limit; no impact on the soil because of a negligible quantity of

solid waste to be disposed of; no impact from waste transport; very minor impact on water because of exclusion of sulphate and sulphite waste. These objectives are tantamount to a markedly reduced overall environmental impact compared with that of the familiar desulphurisation techniques. Finally, the aim is also to reduce, in relation to the recognised BAT, the costs of sulphur absorption in terms of energy and chemical agents used.

"Currently available flue gas treatment processes enable sulphur dioxide to be absorbed via alkaline sodium hydroxide (NaOH) or calcium hydroxide (CaOH) solutions, but these aggravate the impact on water (sulphate and sulphite) and the soil (solid waste). This is why flue gas treatment is rarely practised. The method normally used in Europe to remain below the legal SO_2 emission limit involves the use of low sulphur content feeds. The process tested by REFINARS can be applied to all refineries using FCC without first reducing the sulphur content of feeds.

"Application of the process has made it necessary to build a buffer regeneration plant (recycling the absorbing solution) linked to an existing FCC site. Data on its performance will be collected for comparison with those of BAT currently applied in refineries as laid down in the BREF document for this sector *(see pages 5 to 7)*. All the necessary chemical and environmental analyses will be carried out. The plant was successfully started up in August 2003. The tests will lead to a comparative report on the new process focusing on technical, economic and ecological aspects and including an analysis of its overall impact on the environment.

"As for the final results, we expect to reduce sulphur dioxide emission to less than 550 mg/Nm^3 in the flue gas[1]. We estimate that we will be able to attain an efficiency level of over 85% in removing SO_2 originating from the flue gas with a corresponding recovery of marketable sulphur. The maximum volume of solid waste is expected to be 500 kg/day and sulphate and sulphite concentration in the waste water will be minimal. It is expected that there will be savings of 95% for absorbing solution replacement and 25% for energy compared with the existing BATs which use NaOH. Finally, we count on an overall reduction of 40% of FCC operating costs compared with these same BATs.

"The first results recorded to date have been very encouraging and show that the process works well. They confirm the forecasts regarding the efficiency of SOx removal and the negligible amount of solid waste generated. At the next stage of the project, the regeneration unit will be adapted so as to ensure its continuous and stable operation under various operating conditions. Eventually, the results should be validated on the basis of a cost/benefit analysis to ascertain the economic viability and environmental significance of the process and, of course, to ensure that these results are widely disseminated.

"LIFE REFINARS may bring real progress in preventing pollution in oil refineries and in industries facing similar pollution problems such as the metal industry and sulphuric acid production plants. In the oil refinery sector alone, it may have a direct impact on 54 cracking units and 49 sulphur recovery units throughout the Union."

[1] *Nm^3: normal cubic metres at 0°C, 1 bar.*

Below: desulphurised flue gas stack.

Previous page: buffer solution loading facilities.

Reference: LIFE00 ENV/IT/000012
Total eligible costs: EUR 8 765 105
LIFE contribution: EUR 1 274 432
Beneficiary: ENI SpA, Via Laurentina, 449, IT-00142 Rome

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Duration: from 1 October 2001 to 30 September 2004

LIFE-Third Countries project in Russia

A new environmental law for Russia and its application in four pilot companies

A special feature of this LIFE project was its objective to introduce a new law in Russian legislation and have it applied to specific situations in four pilot companies in St. Petersburg and its region. Its results make a notable contribution to protecting the environment, in particular in the Baltic basin.

The Russian working party on a study visit to the Uppsala municipal water treatment plant (Uppsala, Sweden).

The basin of the Baltic Sea is one of the world's largest brackish ecosystems and also one of its most vulnerable. Any disturbance of the environment may have serious consequences. Surrounded by large coastal cities and criss-crossed by very busy shipping routes, it is currently under threat. St. Petersburg and its region, an important industrial area, greatly contribute to the problem.

The Helsinki Convention1 (1992), ratified by the Russian Federation in 1998, established a framework for cooperation to reduce pollution generated in particular by large cities. The management body of the Convention is the Helsinki Commission (HELCOM), which has presented recommendations on "best available techniques" (**BAT**) and, based upon these, authorised levels for the disposal of the main pollutants.

In the Russian Federation, environmental legislation is based on federal maximum allowable concentration (**MAC**) standards. A tax scheme according to the "the polluter pays" principle was introduced in 1991. During the years of economic transition, the scheme has often been perceived as an obstacle to the growth of companies which have been constrained to making major investment in order to comply with the standards. As a result, they often prefer to simply destroy waste, which is less costly. Based on the effects of pollution, the MAC system therefore differs fundamentally from the BAT principle which is focused on production processes as such and on prevention.

It is in this context that the city of St. Petersburg and the Leningrad region (State Duma) have received support from LIFE–Third Countries for a joint project with Finland and Sweden. The aim is to work out a BAT-based system for fixing limits of polluting waste in accordance with HELCOM's recommendations, which should serve as a basis for improving environmental conditions.

Initially there was no legal basis for technological standardisation of production processes. In parallel with cooperation with federal and regional authorities to adopt a BAT-based law on operating authorisation, the LIFE project therefore included experimental action in pilot companies representative of major activities in the region.

After 100 companies had been evaluated, four were selected: the waste water treatment plant (WWTP) of the city of Pushkin, a fish processing plant (ROK-1), a tanning company (KHOZA) and the St. Petersburg cardboard and printing plant (KPK).

The project was led by a working party composed of experts representing all the bodies responsible for environmental matters and a group of scientists. The project included pollution prevention training, follow-up, verification and evaluation of waste water, implementation of specific environmental measures after approval by the competent authorities, and assessment and dissemination of results. In addition to conferences, seminars and workshops, on-site visits were organised in the two partner countries.

An environmental audit was carried out in each pilot company. They were supplied with a list of controllable pollutants and a timetable for BAT implementation. They benefited from a special reduction of pollution tax, and the difference could be devoted to BAT. The rule was that they should use their own resources to implement the measures.

For example, WWTP launched a programme for nutrient recovery from waste water, mainly intended to reduce maximum total nitrogen concentration from the initial 14 mg/l to 13 mg/l in 2004 and 10 mg/l in 2006. ROK-1 laid a system of pipes to channel hot water for cleaning installations and reuse the water afterwards; waste was reduced by 50% for waste water and 10% for chemical or biological oxygen requirement. In the KHOZA tanning company, the annual volume of waste, expressed in tonnes of raw material, dropped from 42.5 to 33.8 m^3, and the company compiled plans for building a modern water treatment plant. At KPK, fresh water consumption dropped from 60 to 80% and the quantity of residual water discharged into the Izora river is now between 1.6 and 2.4 million m^3/year compared with 6 to 7.6 million previously. Two pilot companies received operating authorisation in accordance with the BAT criteria upon completion of the project.

With regard to legislation, the amendments drawn up by the working party on operating licences are now incorporated into Russian law. Although the amendments relating to a new system for paying pollution tax have not yet been adopted, this is a major step forward, which is further enhanced by the example set by the LIFE project.

At the KHOZA tanning plant.

1 http://www.helcom.fi/helcom.com/convention.html#Article2

Mr Valery Zaytsev, head of the LIFE working party and of the Baltic Special Maritime Inspectorate.

Reference: LIFE99 TCY/ROS/022
Total eligible cost: EUR 200 425
Contribution LIFE: EUR 141 000
Beneficiary: Scientific Ecology Research Centre, Russian Academy of Sciences, 18 Korpusnaja ul., RU-194110 St. Petersburg

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Duration: from 1 January 2001 to 30 June 2002

LIFE-Environment project in Sweden

Steel goes green - A cleaner steel industry thanks to electrodialysis

The AvestaPolarit steelworks has with LIFE funding set up a process for deacidification of its waste water through electrodialysis. The results are very encouraging: the plant's discharge of nitrates diminished by 55% and, thanks to the recycling enabled by the system, the amount of hydrofluoric acid and lime used has diminished by a quarter. A new "best available technique" (BAT) within the meaning of the IPPC Directive?

The AvestaPolarit steel plant of Nyby/Torshälla is difficult to find, surrounded by nature and located some 100 kilometres west of Stockholm, not far from the attractive town of Eskilstuna which is renowned for its old forges. This comes as a surprise in particular to people who believe that steel production is inevitably associated with smoky industrial areas. But this is Sweden, a country with vast spaces where great care is taken to ensure that factories fit in with the landscape and the environment. At Nyby/Torshälla, high trees surround the site, largely screening off the steel works.

The Nyby plant is specialised in cold rolling of flat stainless steel products. The blast furnaces and hot rolling mills are installed at Avesta, 120 km to the north. Steel coils are transported by train or lorry from Avesta to Nyby where they are cold rolled into high-grade stainless steel. Every week the plant produces 3 500 tonnes of stainless steel, 70% of which is exported. It is used for plating high-speed trains, cladding buildings and telephone booths and to manufacture food equipment in accordance with European standards.

The Nyby/Torshälla steelworks at the shore of Lake Mälaren.

Stainless steel coils awaiting loading.

Nitrate

Cold rolling involves quenching the steel in nitric and hydrofluoric acid baths to remove all traces of oxidation from the steel sheet. Acid waste is neutralised with lime which reduces its metal and fluoride content. However, it has hitherto not been possible to efficiently treat the nitrate generated by the nitric acid which was consequently wholly discharged into Lake Mälaren on whose shores the steelworks is situated.

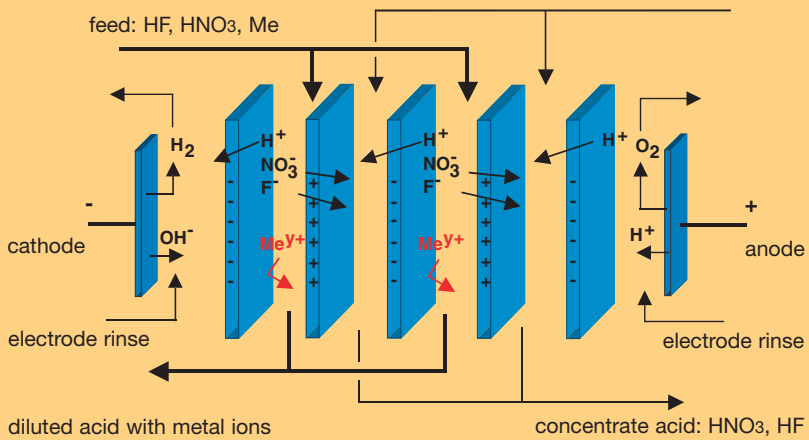
This lake, the third largest in Sweden, is linked to the Baltic Sea near Stockholm. In the middle of the 1990s, the Swedish Parliament required industry to help reduce nitrates in the Baltic (20% reduction in relation to levels recorded in 1990). AvestaPolarit, which at the time discharged 250 tonnes of nitrogen in the form of nitric acid, was identified as being the single most polluting site at Lake Mälaren.

Accordingly, the firm decided in 1998 to undertake research in collaboration with the Swedish Environmental Research Institute (IVL) to find ways of optimally recycling its waste water. "*We already knew that electrodialysis was the most efficient technique to treat nitric acid: in the laboratory, 45g nitrate can be reduced to 4g through this process. But there was no full-scale system in steelmaking.*"

From the research to the pilot stage the project was coordinated by Thorsten Schneiker, a young German chemical engineer who has become Swedish by adoption. He adds: "*It took two years, from 1999 to 2000, before the system was stable. The main difficulty was to find the proper balance and the right materials for the membranes and electrodes. For instance, the electrodes used to erode very quickly but nowadays they need to be changed only every three months.*"

Membranes and electrodes are the two key components in **electrodialysis** *(see box and graph)*. Briefly, this technique consists of passing waste aqueous solutions – acidic and metal-charged – through an electric field and a series of polystyrene membranes (several hundred). In addition to recovering part of the acids (55% of nitric acid and 25% of hydrofluoric acid), the process makes it possible to virtually eliminate metals and reduce the amount of residual sludge.

The electrodialysis process applied to cold rolling as set up under the LIFE project.



What is electrodialysis?

Electrodialysis (ED) is an electrochemical process through which ions contained in an aqueous solution can be extracted. For this extraction, ions are passed through selective (anionic and cationic) membranes under electric potential.

In this way, only anions can pass through an anionic membrane and only cations through a cationic membrane. By combining several membranes which alternately let through positive and negative ions, particular ions can be eliminated from the water. In some columns, there is a concentration of ions and in others the ions are removed. Non-charged particles are not eliminated.

Electrodialysis is used in particular in desalinating sea water. At the end of the process, fresh water and brine are recovered.

Source: Lenntech B.V., NL-2629 HH Delft.

Recognition

Once the system had been developed in the laboratory, it had to be constructed at full scale. AvestaPolarit decided to move ahead. "*The investment was risky and we were competing with other investments within the group but in the end it was our project which obtained financing*", Per Nymark, Quality and Environment Director at the Nyby/Torshälla site explains.

To the question whether obtaining LIFE co-financing in 2000 had influenced the steelworks' decision, Per Nymark replies without hesitation: "*The decision to invest had already been taken before LIFE. Of course, we were very happy to obtain this co-financing but what LIFE has contributed is first and foremost external recognition.*" Thorsten Schneiker confirms: "*When the local press talked of obtaining LIFE funding, public opinion throughout the region was duly impressed.*"

Between 2000 and 2002, LIFE will have contributed 19% (about EUR 367 000) of the costs of the project, the remainder (EUR 1.6 million) being provided by the steel concern itself. An adjacent building has been added to the waste water treatment unit. It houses the dialysis equipment, involving EUR 1 281 million investment. And it has been working since January 2002; from an ecological point of view, by reducing pollution due to acid and residual sludge through electrodialysis, "*but also from an economic point of view*", as Per Nymark emphasises: "*Thanks to recycling, our annual purchase of nitric acid has diminished from 2 100 to 1 000 tonnes and hydrofluoric acid from 1 000 to 750 tonnes. We have also greatly reduced our use of lime.*"

The analysis carried out by the Swedish Environmental Research Institute has shown that there has been a notable reduction of eutrophying pollutants in Lake Mälaren, in particular through a reduction in nitrate waste.

The installation also makes it possible to reduce consumption of non-renewable energy. The quantity of electricity used in the recycling process is less than the quantity of energy that would be required for the production and transport of fresh acid, as was exclusively the case before the installation was set up. In terms of financial amortisation, it is currently estimated that the process generates a yield on investment of about 10% a year.

"*The aim is to achieve closed-loop recycling*", adds Per Nymark. "*We have not yet found the ideal solution: we still discharge 100 tonnes of nitrogen a year but 50 tonnes is a realistic target which we can achieve in the relatively short term. We want absolutely to minimise and in particular to reutilise our waste. In this regard, our project forms part of the wider plan of the whole group, i.e. to strive to work in a closed loop, not only with the waste but also the energy and everything that enables us to harmonise ecology and economy.*"

Thorsten Schneiker and Per Nymark, who are in charge of the project, in the electrodialysis room at Nyby/Torshälla.

Monitoring rolling operations.

Transferability

In the meantime, the innovators of Nyby appreciate the interest enkindled by their project. Nitric acid recycling through electrodialysis will soon be adopted in other units of the steel group, particularly as the Swedish government encourages steel producers to adopt the process in their industrial installations. Also a major German producer has expressed an interest in the process.

Thorsten Schneiker has had various opportunities to present the project at seminars and other international gatherings. "*The process is eminently transferable, not only in the steel industry. Over and above the technical success, I am proud of the repercussions we seem to have, in particular thanks to LIFE. Electrodialysis will form part of a new edition of the "**BREF**"[1] devoted to the ferrous metal processing industry in accordance with the European IPPC Directive. In the fight against industrial nitrates, the process is in fact a new reference, i.e. what the Directive calls a "best available technique.*"

Reference: LIFE00 ENV/S/000853
Eligible total cost: EUR 1 933 484
LIFE contribution: EUR 367 158
Beneficiary: AvestaPolarit AB, Cold Rolled Nyby, SE-644 80 Torshälla

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Duration: from 1 December 2000 to 31 August 2002

AvestaPolarit and European steel research

Together with other leading representatives of the European steel industry brought together within Eurofer (Arcelor, ThyssenKrupp Steel, Corus and Riva), AvestaPolarit is involved in a dialogue initiated by the Research DG of the European Commission to establish a technological platform, a strategic agenda and an action plan to give a new impetus to steel research in Europe in a more long-term perspective[1]. In addition to industrialists, this dialogue is open to steelworkers' trade unions, partner industries, universities, public and private research institutes, users and other European institutions and representatives of the Member States. Presentation of the technological platform is planned for spring 2004. For steel research, the European Union has earmarked EUR 43 million for 2003 and 2004 to meet the challenges of the coming decades:

- Enhancing competitiveness of the European steel industry at global level;
- Improving working conditions (risk control, safety, reduced work intensity) in the framework of a social dialogue, and also training;
- Continuing endeavours to protect the environment, preserve raw materials and control energy consumption, in particular for a substantial reduction of CO_2 emission under post-Kyoto commitments.

Future LIFE-Environment demonstration projects will play a role in this context.

[1] For more information: press release IP/03/1074 of 23 July 2003 at http://europa.eu.int/rapid and http://www.cordis.u/callsteel-rtd/home.html

[1]) BREF: reference document for technologies covered by the IPPC Directive (see pages 6 to 9). For each sector of activity, it presents the "best available techniques" for integrated pollution prevention and control. The BREF devoted to ferrous metal processing goes back to December 2001. Referring to electrodialysis, it is noted that the technique is not yet fully developed and is proving to be costly, in particular because of short membrane life: "Acid regeneration processes such as electrodialysis (…) are under development or being tested. This technology (…) is much too young / not proven / too expensive. From analogy with more traditional membrane processes, a short membrane life is expected." As this statement is now contradicted by the Torshälla experience (e.g. membranes are changed only twice a year), a revision of BREF 2001 has been recommended for 2005.

Name Financial Instrument for the Environment (LIFE)

Type of funding cofinancing of actions benefiting the environment in the European Union, countries of Central and Eastern Europe acceding to the European Union and certain third countries.

LIFE covers three areas: **"LIFE-Nature"**, **"LIFE-Environment"** and **"LIFE – Third countries"**.

Aims

> with a view to achieving sustainable development in the European Union, to contribute to working out, implementing and updating EU environment policy and legislation;
> studying new solutions to EU-wide environmental problems.

Beneficiaries any natural or legal person, provided that the funded projects meet the following general criteria:

> the projects must be in line with EU priorities and contribute to the above-mentioned objectives;
> they must be presented by financially and technically reliable participants;
> they must be feasible in terms of technology, timetable and budget, and have a sound cost/benefit ratio.

Types of projects eligible

> LIFE-Nature covers projects for nature conservation which contribute to maintaining or restoring natural habitats and/or species populations to favourable conservation status within the meaning of Directive 92/43/EEC.
> LIFE-Environment covers exemplary projects which include concern for the environment and sustainable development in land-use management, promote sustainable water and waste management or reduce the environmental impact of economic activities. Five areas are given priority for funding: land-use development and planning, water management, impact of economic activities, waste management, and integrated product policy.
> LIFE – Third Countries covers projects which contribute to establishing management capacity and structures in respect of the environment, and to developing policies and action programmes in this domain in countries bordering the Baltic or the Mediterranean other than the countries of Central and Eastern Europe that are candidates for accession.

Implementation Member States or third countries submit proposals to the Commission for projects to be co-financed. Each year, the Commission fixes the date for submission of proposals and takes a decision on the proposals received. It monitors the financing operations and the implementation of LIFE actions. Projects are monitored on site through accompanying measures and, in the case of LIFE-Nature, forms of cooperation among similar projects are encouraged ("Co-op" measure).

Duration of funding 5 years (2000-2004).

Allocation from the EU budget about EUR 638 million, divided as follows: EUR 300 million for LIFE-Nature, EUR 300 million for LIFE-Environment and EUR 38 million for LIFE – Third countries.

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