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ENVIRONMENTAL PROTECTION AGENCY

An Ghníomhaireacht um Chaomhnú Comhshaoil

WASTEWATER TREATMENT MANUALS

CHARACTERISATION OF INDUSTRIAL WASTEWATERS

This document contains 61 pages

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ENVIRONMENTAL PROTECTION AGENCY

ESTABLISHMENT

The Environmental Protection Agency Act, 1992, was enacted on 23 April, 1992 and under this legislation the Agency was formally established on 26 July, 1993.

RESPONSIBILITIES

The Agency has a wide range of statutory duties and powers under the Act. The main responsibilities of the Agency include the following:

- the licensing and regulation of large/complex industrial and other processes with significant polluting potential, on the basis of integrated pollution control (IPC) and the application of best available technologies for this purpose;
- the monitoring of environmental quality, including the establishment of databases to which the public will have access, and the publication of periodic reports on the state of the environment;
- advising public authorities in respect of environmental functions and assisting local authorities in the performance of their environmental protection functions;
- the promotion of environmentally sound practices through, for example, the encouragement of the use of environmental audits, the establishment of an eco-labelling scheme, the setting of environmental quality objectives and the issuing of codes of practice on matters affecting the environment;
- the promotion and co-ordination of environmental research;
- the licensing and regulation of all significant waste recovery and disposal activities, including landfills and the preparation and updating periodically of a national hazardous waste plan for implementation by other bodies;
- preparation and implementation of a national hydrometric programme for the collection, analysis and publication of information on the levels, volumes and flows of water in rivers, lakes and groundwaters; and
- generally overseeing the performance by local authorities of their statutory environmental protection functions.

STATUS

The Agency is an independent public body. Its sponsor in Government is the Department of the Environment. Independence is assured through the selection procedures for the Director General and Directors and the freedom, as provided in the legislation, to act on its own initiative. The assignment, under the legislation, of direct responsibility for a wide range of functions underpins this independence. Under the legislation, it is a specific offence to attempt to influence the Agency, or anyone acting on its behalf, in an improper manner.

ORGANISATION

The Agency's headquarters are located in Wexford and it operates five regional inspectorates, located in Dublin, Cork, Kilkenny, Castlebar and Monaghan.

MANAGEMENT

The Agency is managed by a full-time Executive board consisting of a Director General and four Directors. The Executive Board is appointed by the Government following detailed procedures laid down in the Act.

ADVISORY COMMITTEE

The Agency is assisted by an Advisory Committee of twelve members. The members are appointed by the Minister for the Environment and are selected mainly from those nominated by organisations with an interest in environmental and developmental matters. The Committee has been given a wide range of advisory functions under the Act, both in relation to the Agency and to the Minister.

WASTEWATER TREATMENT MANUALS

CHARACTERISATION OF INDUSTRIAL WASTEWATERS

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PREFACE

The Environmental Protection Agency was established in 1993 to license, regulate and control activities for the purposes of environmental protection. In Section 56 of the Environmental Protection Agency Act, 1992, it is stated that: *The Agency may, and shall when requested by the Minister, give information or advice or make recommendations for the purposes of environmental protection, to a local authority or to local authorities generally in relation to the performance of any of its or their functions and the authority or authorities shall have regard to any such information or advice given or recommendations made.*
Without prejudice to the generality of subsection (1), information, advice or recommendations under this section may relate to ....the standards, conditions or criteria to be applied, or the guidelines, codes of practice or procedures to be followed, for the purposes of environmental protection in relation to any development, process or practice either generally or of a particular class.

This manual has been prepared to provide guidance on the characterisation of industrial wastewater. This will assist local authorities in processing, Water Pollution Act applications/licence reviews, and discharge consents under the Environmental Protection Agency Act, 1992 and the Waste Management Act, 1996. The manual may also be of assistance to applicants applying for the above licences.

Chapter 1 explains the importance of, and sets out a methodology for characterising an industrial wastewater.

Chapters 2, 3, 4 and 5 explain in greater detail the elements involved (desk study, site visit and biological/physico-chemical tests) in characterising an industrial wastewater.

Chapter 6 provides a summary table which may be used to evaluate the information collected during the characterisation.

A series of appendices contain, *inter alia* recommended forms which should be completed by persons(s) discharging or seeking permission to discharge wastewaters to sewers, surface water or groundwater. Suggested draft consent/licence conditions which were agreed between the EPA and the County and City Engineers' Association are included in Appendix D.

The Agency welcomes any suggestions which users of the manual wish to make. These should be returned to the Environmental Management and Planning Division at the Agency headquarters on the enclosed User Comment Form.

ABBREVIATIONS

°/oo	parts per thousand
µS/cm	Micro Siemens per centimetre
°C	Degrees Celsius
Agency	Environmental Protection Agency
BCF	Bioconcentration factor
BOD	Biochemical oxygen demand
BOD_5	Five-day biochemical oxygen demand
CAS	Chemical abstract service
COD	Chemical oxygen demand
DDT	Dichlorodiphenyltrichloroethane
EC	Effective Concentration
EC_{50}	The median effective concentration i.e. the concentration of a test substance which causes a 50% effect on a test response
EPA	Environmental Protection Agency
IC_{50}	The concentration of a test substance which causes 50% inhibition
ICB	Integrated circuit board
IPC	Integrated Pollution Control
ISO	International Standards Organisation
IV	Intravenous
kg/day	Kilogrammes per day
LC	Lethal concentration
LC_{50}	The median lethal concentration i.e. the concentration of a test substance which causes 50% mortality on a test response
log P_{ow}	Log of the partition of a substance between n-octanol and water
mg/l	Milligrammes per litre
MSDS	Material Safety Data Sheet
OECD	Organisation for Economic Co-operation and Development
OFG	Oils, fats and grease

PCB	Polychlorinated Biphenyl
QSAR	Quantitative Structure-Activity Relationships
R phrase	Risk phrase
S phrase	Safety phrase
TIE	Toxicity Identification Evaluation
TLC	Thin Layer Chromatography
TRE	Toxicity Reduction Evaluation
TSS	Total suspended solids
Tu	Toxic units
VOC	Volatile Organic Compounds
VSS	Volatile Suspended Solids
WQMP	Water Quality Management Plan

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GLOSSARY OF TERMS

Acute toxicity: both the exposure time and observation periods are short over the life cycle of the test organism; this would be in the order of minutes for bacteria and usually up to 4 days for fish;

Additivity: where the toxicity of a mixture is the sum of the toxicity of the individual components;

Aerobic process: a process which is dependent on microorganisms which require oxygen for their metabolism;

Algae: (singular, alga) comparatively simple plants containing photosynthetic pigments. A majority are aquatic and many are microscopic in size;

Aliphatic: organic compounds containing open chains of carbon atoms rather than closed rings of carbon;

Anaerobic process: a process that is carried out without the presence of air or oxygen;

Anion: an atom which has gained one or more electrons or a negatively charged group of atoms, e.g. Cl^- in NaCl;

Antagonism: antagonism which prevails between substances which, on mixing show lower toxicity than that which could be expected on the basis of the toxicity of individual substances;

Aromatic: compounds containing a benzene ring;

Bioaccumulation: a progressive increase in the amount of a chemical in an organism or part of an organism which occurs because the rate of intake exceeds the organisms ability to remove the substance from the body;

Bioassay: a test used to evaluate the potency of a substance or mixture of substances by comparing its effect on an organism or biological process, relative to the similar organism or biological process exposed to a control in which the substance(s) are absent;

Biodegradable: capable of being reduced or decomposed by the natural action of microorganisms;

Biodegradation: the breakdown of material by the action of microorganisms;

BOD (Biochemical Oxygen Demand): a measure of the amount of material present in water which can be readily oxidised by microorganisms and is thus a measure of the potential of that material to take up the oxygen in water;

Cation: an atom which has lost one or more electrons or a positively charged group of atoms e.g. Na^+ in NaCl;

Chronic: both the exposure period and observation periods are taken over a significant part of the life cycle of the test organism such as 10% or more;

COD (Chemical Oxygen Demand): a measure of the total amount of chemically oxidisable material present in liquid;

Complex wastewater: a wastewater discharge of variable and mixed composition (i.e. where the observed toxicity cannot be accounted for fully, nor numerically limited and controlled, by chemical-specific limits);

Crustacea: class of animals which have hard shells which are shed periodically as the animal grows;

EC_{50}: the concentration of a test substance which causes specified effects in half (50%) of a number of tested organisms;

Ecotoxicological: the impact of a pollutant on an ecosystem, habitat or individual species;

Ethers: organic compounds of the type R-O-R, where R and R' are alkyl or aryl, they are formed from the condensation of two alcohol molecules, e.g. $C_2H_5O.C_2H_5$;

Halogenated organic compounds: organic chemicals containing one or more of the halogens, fluorine, chlorine, bromine or iodine;

Hazardous substance: the inherent potential or capacity of a substance to cause adverse effects on living organisms;

Heavy metals: a term for those ferrous and non-ferrous metals having a density greater than about 4 which possess properties which may be hazardous in the environment. The term usually includes the metals copper, nickel, zinc, chromium, cadmium, mercury, lead, arsenic, and may include selenium and others;

IC_{50}: the concentration of a test substance which causes a 50% reduction in the rate of a biochemical reaction;

Inhibitor: a substance which reduces the rate of a reaction;

LC_{50}: the concentration of a substance which kills 50% of test organisms in a given exposure period;

Lethal: causing the death of organisms;

Lipophilic substances: fat loving or water-repellent;

List I substance: As listed in the EC Directives 76/464/EEC (Dangerous Substances Directive) and 80/68/EEC (Groundwater Directive) and amendments;

List II substance: As listed in the EC Directives 76/464/EEC and 80/68/EEC and amendments;

Nitrification: conversion of ammonium ions (NH_4^+) to nitrite and nitrate ions (NO_2^-, NO_3^-) by microorganisms;

Polar solvent: a solvent, the molecules of which have good solvating power;

Sub-chronic: a period of exposure that falls between acute and chronic exposure periods;

Sub-lethal: a biological response to a toxicant below the level that causes death;

Synergism: where the toxicity of a mixture exhibits greater-than-additive total toxic effect;

Toxicity: potential or capacity of a test material to cause adverse effects on living organisms, generally a poison or a mixture of poisons. Toxicity is a result of dose or exposure concentration and exposure time, modified by variables such as temperature, chemical form and availability;

Trophic level: a general term for each step of a food chain or food pyramid;

VOC: volatile organic compound or organic chemical;

1. INTRODUCTION

1.1 GENERAL

The quality of wastewater discharges in Ireland has traditionally been controlled by the use of physical and chemical parameters, albeit with some knowledge of their biological effects. Local authorities have increasingly requested information derived from laboratory toxicity tests to control the quality of wastewater discharges. The EPA has encouraged this trend and requested information also regarding inhibition tests and biodegradability based tests. At international level, the OECD have recommended that member countries adopt the principle of toxicity testing as one factor in decision making to effectively regulate wastewater discharges, with the added advantage of harmonising pollution control across international boundaries.

Efforts should be concentrated on the risks associated with dangerous substances such as stable organic substances or heavy metals which are capable of giving rise to:

- long-term effects;
- upsetting the performance of wastewater treatment plants; and/or
- compromising the possible reuse of sludge.

1.2 LICENSING OF WASTEWATER DISCHARGES IN IRELAND

Primary responsibility for the control of water pollution rests with local authorities. The necessary powers to fulfil this responsibility are provided in the Water Pollution Acts 1977-1990. Some of the provisions of these Acts include:

- section 3, which makes it an offense to cause or permit any polluting matter to enter waters. Twenty such prosecutions were taken by local authorities during 1996;
- section 4, which makes it an offense to discharge any trade or sewage effluent to waters save in accordance with a licence issued by local authorities. Six hundred and seventy one such licences were in force in 1996; and
- section 16, which makes it an offense to discharge trade or other effluent to a sewer save in accordance with a licence issued by the local authority. One thousand two hundred and eleven such licences were in force at the end of 1996, an increase of thirteen since the previous year.

The Environmental Protection Agency Act, 1992 introduced an integrated licensing of emissions (for large/complex and other processes with significant polluting potential) known as Integrated Pollution Control (IPC). This new licensing system is administered by the Environmental Protection Agency (EPA); an IPC licence covers emissions to all aspects of environmental media including emissions to water, air, waste and noise. The processing of IPC applications commenced in 1994 and activities covered by this licensing system are listed in the First Schedule of the EPA Act. The Waste Management Act, 1996 introduced a system of licensing by the EPA of waste disposal activities. The processing of waste licence applications commenced in May, 1997. Under both licensing systems activities are selected for licensing on a phased basis.

Where the wastewater from an IPC activity or a waste disposal activity discharges to a local authority sewer system the consent of the sanitary authority is required. Thus, discharges to sewer even though they may require an IPC or Waste licence also require the consent of the sanitary authority.

It is important that an industrial wastewater discharge is characterised so that its impact on the receiving environment (which could initially be a sewer system) is assessed and to assist identification of priority actions to eliminate/reduce hazardous substances. When an industrial wastewater has been characterised, licence conditions can be drafted to protect the:

- sewer system;
- wastewater treatment plant;
- sludge treatment system;
- land where the sludge is applied;
- aquatic environment which receives the

- (treated) wastewater; and
- landfill where residues are deposited.

1.3 EPA ACT, 1992 (URBAN WASTE WATER TREATMENT) REGULATIONS, 1994

Schedule 4 of the above set of Regulations requires that industrial wastewater entering collecting systems and urban wastewater treatment plants should be subject to such pre-treatment which will:

- protect the health of staff working in collecting systems and treatment plants;
- ensure that collecting systems, wastewater treatment plant and associated equipment are not damaged;
- ensure that the operation of a wastewater treatment plant and the treatment of sludge is not impeded;
- ensure that the discharges from treatment plants do not adversely affect the environment or prevent receiving waters from complying with other Community Directives; and
- ensure that the sludge can be disposed of safely in an environmentally acceptable manner.

1.4 METHODOLOGY

The information required to characterise an industrial wastewater stream comes from the following sources:

- a completed application form;
- a request for further information;
- requests for information under section 23 of the Water Pollution Acts 1977-1990;
- a desk study;
- site visit; and
- biological/physico-chemical analysis.

All sources of information should be used to compliment each other, though for industries which have no trade effluent (i.e. domestic wastewater only), biological/physico-chemical analysis may be sufficient to characterise the wastewater stream. For more complex wastewaters, such as exist in the pharmaceutical sector, the desk study will influence the characterisation strategy and the environmental assessment of the wastewater. For existing activities, the desk study should be followed by a site visit by those involved in processing the application. Figure 1 sets out the elements involved in the characterisation of a wastewater.

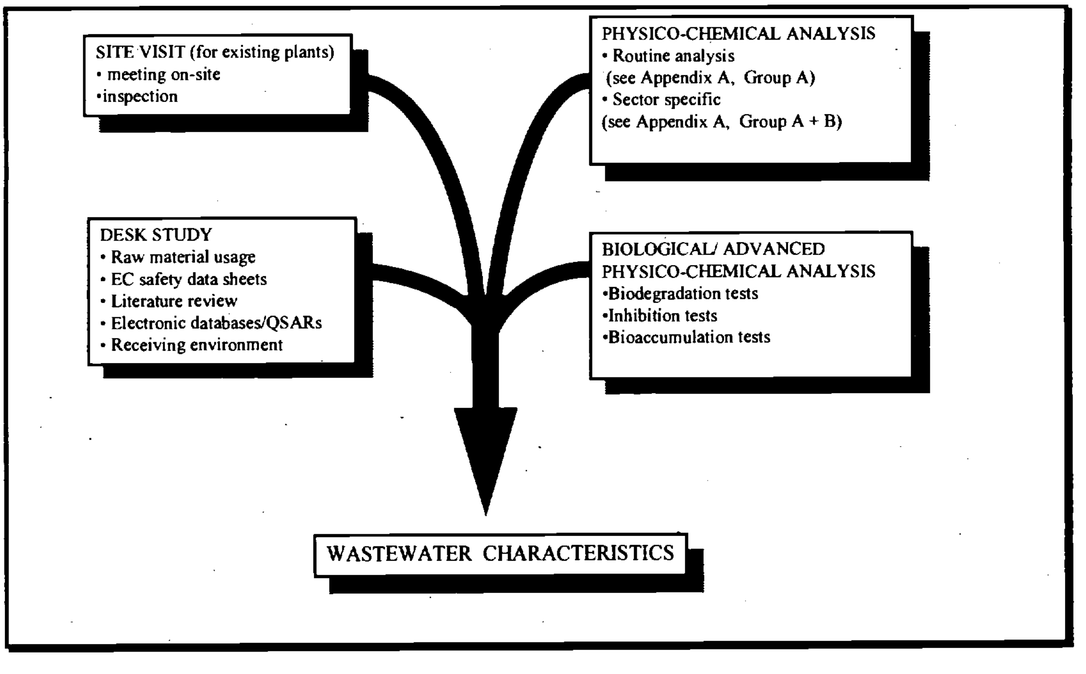

FIGURE 1 CHARACTERISATION OF AN INDUSTRIAL WASTEWATER STREAM

The information sources above can be used in two ways to characterise a wastewater stream:

- identification of the individual chemicals which are present (single chemical approach); and/or
- whole wastewater analysis.

The single chemical approach grew from serious pollution incidents which were the result of the discharge of hazardous chemicals such as mercury and DDT. However, this approach presents a major difficulty to the analytical chemist, as in general only 20 - 30% of the organic carbon compounds in a complex industrial wastewater can be identified. In the whole wastewater approach (favoured by the OECD), the effects of a mixture of chemicals is assessed by measuring the effect a wastewater has on a selected organism. One of the disadvantages of this approach is that in general the effect/toxicity is assigned to only one or a few priority pollutants. However, the two approaches compliment each other, and both are recommended for the characterisation of an industrial wastewater discharge.

Figure 2 on next page is a flow chart of a proposed methodology for characterising a wastewater stream.

Wastewater arisings from restaurants, hotels, guest houses are regarded as commercial activities which are generally of domestic origin. For these wastewaters the parameters which are listed in Group A of Appendix A (BOD_5, COD, pH, temperature, total suspended solids, total nitrogen, phosphorus, fats, oils and grease, detergents and conductivity), along with the general details about the discharge should be supplied by applicants. This information will normally be sufficient to characterise the wastewater stream.

All other industrial activities should be required to complete the details requested in Appendix A (physico-chemical and biological tests) and Appendix B (Inventory of materials). For discharges to sewer, where high levels of sulphate are suspected in the wastewater, the concentration of this parameter should be established. Sulphate may react chemically with the aluminium silicate in concrete, and indirectly by reduction to hydrogen sulphide under anaerobic conditions and subsequently oxidised to sulphuric acid under aerobic conditions.

If significant levels of a substance(s) (whose fate is unknown) are likely to be present in the wastewater, the potential fate and effects of those substance(s) should be examined; Figure 3 sets out a protocol which may be used to assess the impact of individual substances.

In addition to the parameters recommended for all wastewaters, further analysis, based on the type of industry concerned is recommended. The parameters listed in Appendix A should be analysed as a minimum. Analysis of additional parameters may also be necessary following completion of the raw materials inventory (Appendix B).

Where an industrial wastewater is treated biologically, the effect on the treatment plant needs to be evaluated. The inhibition/toxicity of the discharge on the treatment process and the treatability/biodegradability of the wastewater will help establish the likely impact of the discharge on the treatment plant. Where the discharge enters the receiving water the level of toxicity on the aquatic environment should be evaluated. Where the results of the analysis indicates that the wastewater may be toxic to the treatment process or the receiving environment and/or is non-degradable, it may be necessary to supplement the analysis to gain further information. Further investigations/tests may include:

I) chronic aquatic testing;

II) toxicity testing using the recipient microorganisms from the wastewater treatment plant;

III) Toxicity Identification Evaluation (TIE) leading to Toxicity Reduction Evaluation (TRE);

IV) simulation biodegradation testing using recipient microorganisms from the waste water plant or the aquatic environment;

V) bioaccumulation testing from samples that have been previously subjected to (IV) above, and

VI) mutagenic testing, such as the Ames or the umu test.

Further details on these test methods are outlined in Chapter 5. It may be necessary where information is inconclusive or inadequate to set up a laboratory scale treatability/biodegradation study.

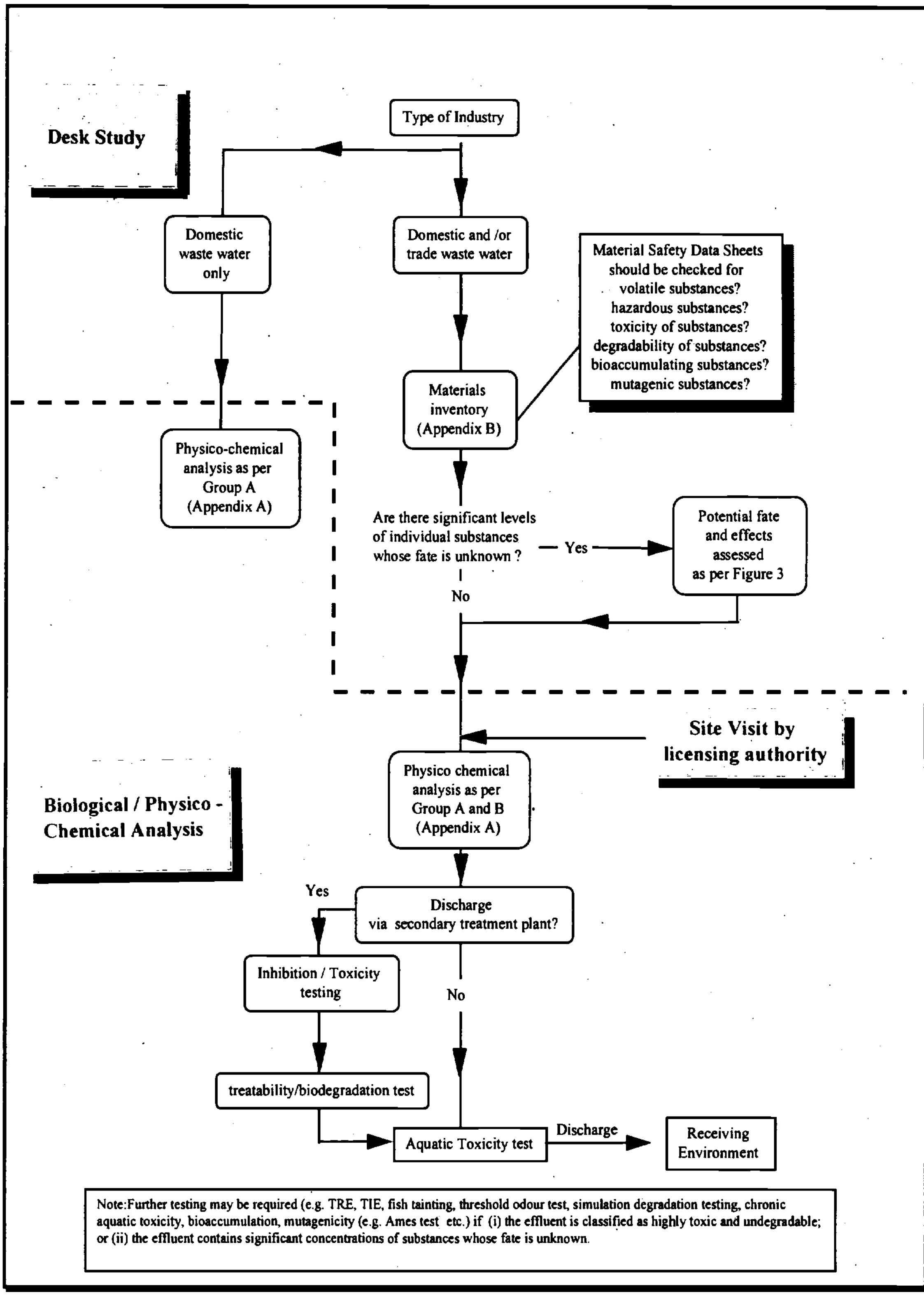

FIGURE 2 METHODOLOGY FOR CHARACTERISING A WASTEWATER STREAM

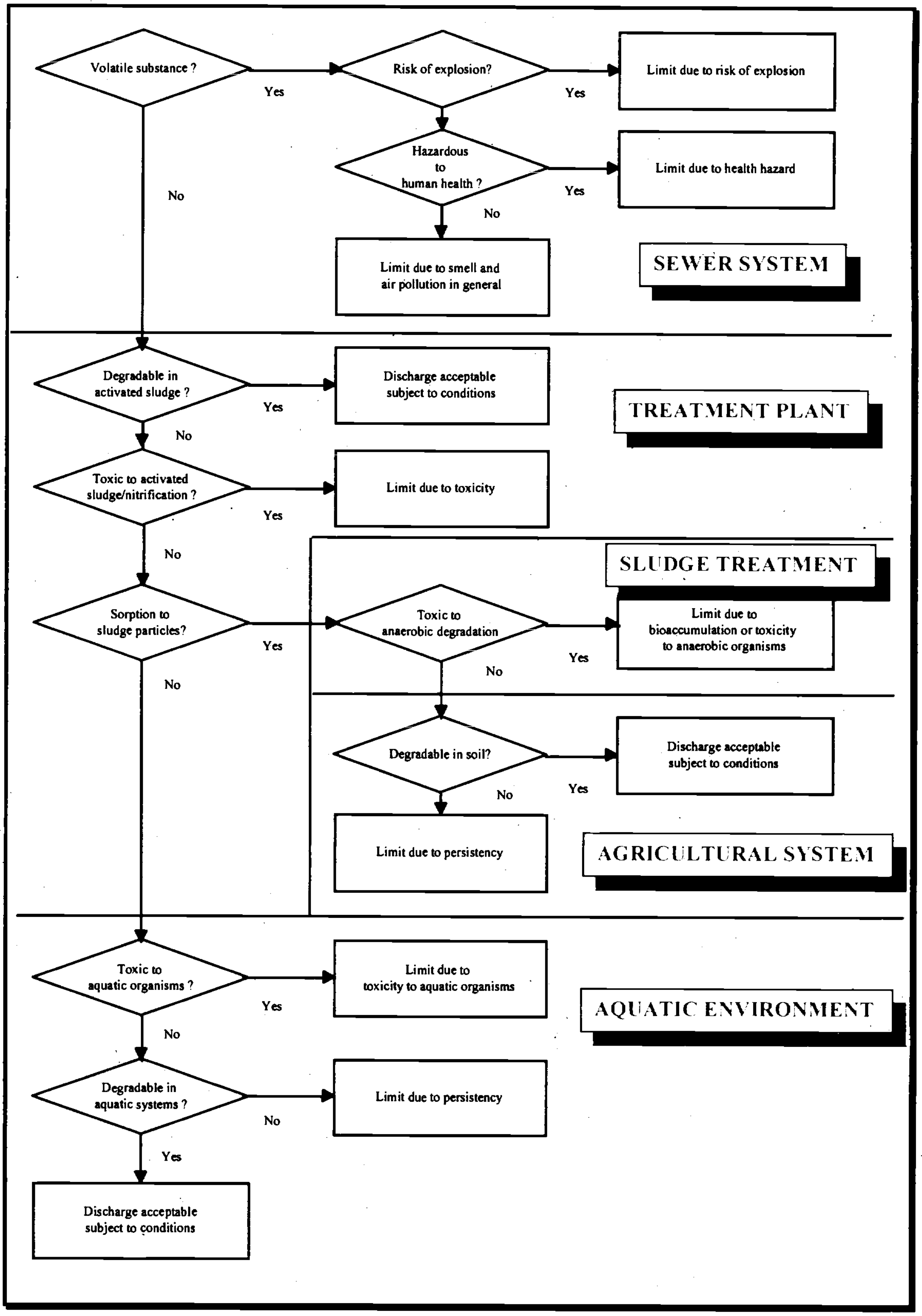

FIGURE 3 FLOW CHART FOR THE CHARACTERISATION OF INDIVIDUAL SUBSTANCES

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2. DESK STUDY

2.1 GENERAL

Having obtained an inventory of chemicals used or produced on-site, the purpose of the desk study is to examine all the information available on the substances which are present in significant quantities in the wastewater. Properly conducted, a desk study may reduce the amount of analytical work. The integral parts of a desk study include:

- determination of the individual components of the raw materials;
- volatility assessment (this gives an indication of the evaporative loss of a substance - measured as atm-m^3/mole);
- toxicity/inhibition assessment (evaluate toxicity to fish, crustaceans, plant/algae, bacteria -measured as LC_{50}, IC_{50}, EC_{50} etc.);
- degradability assessment (determine degradation under aerobic/anaerobic conditions within specified time period (e.g. 28 days)); and
- bioaccumulation (organic substance partitioning between the environment and some surface of the organism- correlates with Log P_{ow}).

The above terms are explained in greater detail in the glossary of terms earlier in this publication.

2.1.1 Materials Inventory

Lists of all the raw materials, intermediates, and products generated including all other materials e.g. process associated cleaning chemicals, water and wastewater treatment chemicals, cooling water/boiler water additives and laboratory chemicals (whose annual usage is greater than 2.5 kg or 2.5 litres) used at an industrial premises should be requested for any industrial discharge of wastewater to waters or sewers.

The list should be assessed along with information collected from:

- an examination of material and safety data sheets (MSDS); and
- a literature review of the chemicals and their environmental effects.

A reconciliation of the quantities of chemicals used and the available information about the fate of these chemicals in the environment will provide useful information for evaluating the potential hazards from the wastewater.

2.1.2 EC Material and Safety Data Sheets

The European Commission Directive 67/548/EEC (Classification, Packaging and Labelling of Dangerous Substances) was the first in a series of legislative measures taken to identify all the toxicological, physico-chemical, ecotoxicological properties of substances, and toxicological and physico-chemical properties of preparations coming on the market, which may constitute a risk during normal handling or use.

Substances which are classified as dangerous to the environment are assigned the symbol "N" and will be listed as such in material and safety data sheets. Appropriate "R" phrases indicating the level of risk are also assigned. Examples of some R phrases and their associated risk are set out in Table 1 below.

TABLE 1 SELECTED RISK PHRASES AND ASSOCIATED RISK TO THE AQUATIC ENVIRONMENT

R phrase	Risk to Aquatic Organisms
R50	very toxic to aquatic organisms
R51	toxic to aquatic organisms
R52	harmful to aquatic organisms
R53	may cause long-term adverse effects in the aquatic environment

Labels (R phrases etc.) should be seen as alerting the user to the potential affect that substances may have on the receiving environment (mostly the aquatic).

2.1.3 Literature Review

It is estimated that some 50,000 dangerous chemicals exist in the European Union and of these some 4,500 are potential List I substances (Dangerous Substances Directive 76/464/EEC). Hence, for the foreseeable future much of the information on the dangers posed by individual chemicals and preparations will be determined from a review of material safety and data sheets and available literature.

A literature review may provide a key to the likely impacts of a substance or preparation on the environment. For example, chemicals with relatively low vapour pressure, high adsorptivity onto solids, or high solubility in water are unlikely to vaporise and become airborne in a sewer. However, chemicals with high vapour pressures or, with less affinity for solution in water or, adsorption to solids and sediments are likely to vapourise and potentially cause explosions. A further example would be chemicals that are likely to be gases at ambient temperatures and which have low water solubility and low adsorptive tendencies. These are less likely to transport and persist in soils and water.

Several good environmental handbooks exist which provide much useful environmental data on polluting chemicals (e.g. Verschueren, 1983 and Howard 1990, 1991).

2.1.3.1 *Electronic Databases*

Computerised databases on the ecotoxicity and degradability of chemicals represent the best updated sources of information today. A number of databases are available on-line and on CD-ROM packages at relatively modest expense. Packages are available that contain information on the toxic effects of chemicals to aquatic organisms and plants comprising data from 1970 (e.g. AQUIRE, ECOTOX). Extensive information on the degradability of substances can be obtained from bibliographic databases such as BIOSIS, Chemical Abstracts, Pollution Abstracts, Aqualine and the U.S. EPA Risk Reduction Engineering Laboratory Treatability Database (1994).

2.1.3.2 *Prediction of Toxicity using Quantitative Structure-Activity Relationships (QSAR)*

The toxicity of the members of certain groups of substances is known to correlate to some extent with the molecular structure or to the number of substituents attached to a substance. For example, Figure 4 shows how the toxicity of chlorophenols increases with the addition of chlorine atoms to the phenol ring.

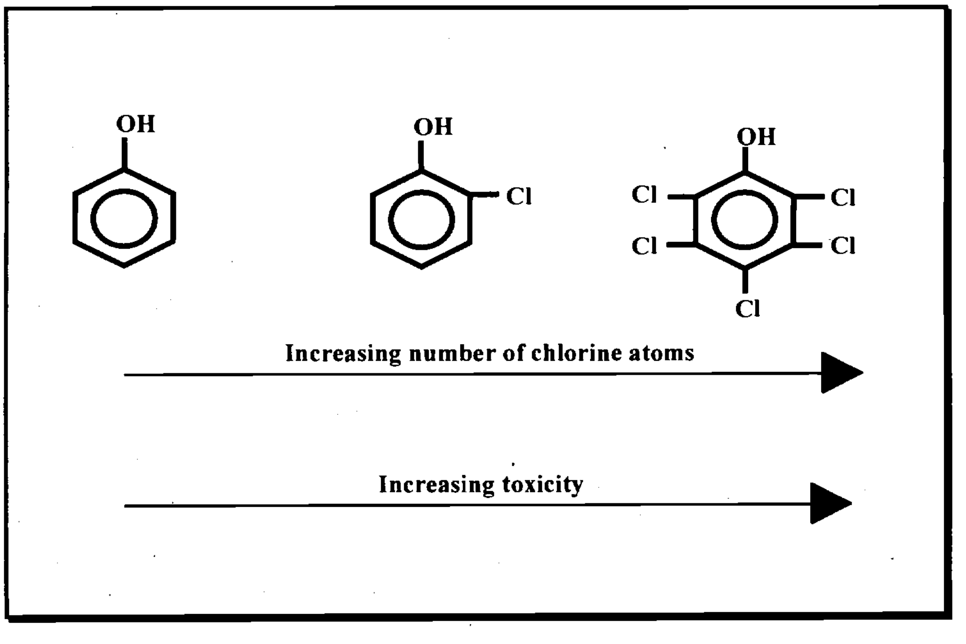

FIGURE 4 THE RELATIONSHIP BETWEEN TOXICITY AND CHLORINE ATOM ADDITION TO A PHENOL RING

Empirical knowledge has been used in a number of cases to permit cautious estimates of the toxicity of a substance where little or no data has been available. The development of "quantitative structure-activity relationships" (QSAR) has been based upon evaluations of bioaccumulative tendency, toxicity and physico-chemical characteristics. The development of QSARs for toxicity proceeds in principle along the following lines:

- critical evaluation of available toxicity data for substances in common group (e.g. LC_{50} values);
- collection and evaluation of physico-chemical and stoichiometric data (e.g. octanol/water partition coefficient, solubility, molecular weight, molecular structure including number of carbon atoms, aromatic rings etc.); and
- calculation of mathematical correlations.

Many QSARs have been developed by the US EPA (1988) for over 40 groups of organics comprising the following three types:

- neutral organics which are expected to have a general action mechanism (narcotic effect) including alcohols, ketones, ethers, aromatic and aliphatic hydrocarbons;
- organic substances with more specific action mechanisms - i.e. containing reactive groups or ionisable functional groups including anilines, phenols and epoxides; and
- surfactants including the following groups: anionic (negatively charged), non-ionic and cationic (positively charged).

It should be noted that in some cases these QSARs have weak correlations and in all cases QSARs should only be used to indicate a level of toxicity within the specific relationships on which the correlations are based.

2.1.4 Receiving Environment

The impact of any discharge (regardless of the level of treatment) on the receiving water should be assessed. The following where relevant should be taken into account:

- Urban Wastewater Treatment Directive (91/271/EEC) as implemented by S.I. 419 of 1994;
- Freshwater Fish Directive (78/659/EEC) as implemented by S.I. 293 of 1988;
- Shellfish Directive (79/923/EEC) as implemented by S.I. 200 of 1994;
- Bathing Water Directive (76/160/EEC) as implemented by S.I. 155 of 1992 and S.I .230 of 1996;
- Surface Water Directive (75/440/EEC) as implemented by S.I. 294 of 1989;
- Groundwater Directive (80/68/EC) as implemented by S.I. 271 of 1992;
- The relevant Water Quality Management Plan;
- Memorandum No.1: Technical Committee on Effluent and Water Quality Standards; and
- Prescribed environmental quality standards.

The estimated flow in the receiving water should be determined in terms of its 95 and 99.5 percentile flow. The EPA publication (1995) on hydrological data may assist in this regard. Water quality management (WQM) plans should be consulted to establish the beneficial use to which the water body has been assigned, and the percentile flow figure which will be used to assess the dilution and assimilative capacity of the stretch of water body. In general, the receiving water standards in WQM plans, apply only at flows equal to or greater than the 95 percentile flow. However, in cases where the substance is toxic (such as heavy metals), the 99.5 %ile flow should be used for such calculations (in practice the minimum recorded dry weather flow is used if available).

Flow criteria used in WQM plans are normally subject to review, typically at intervals of five years. It is therefore important that the most up-to-date flow figures are used when assessing the impact on the receiving water. Appendix C contains some useful formulae for the estimation of the dilution and assimilative capacity of the receiving water course.

2.1.5 Summary of Desk Study Information

Table 2 is a summary checklist of the parameters in a desk study and where information on these parameters may be sourced.

TABLE 2 CHECKLIST OF ITEMS TO BE CONSIDERED IN A DESK STUDY

Parameter[Note 1]	Desk Study to Analyse
Composition and variability of wastewater	• Historical data • Material Safety Data Sheet (MSDS) information • Process conditions • Perform Mass Balances • Discharged Volumes
Biodegradability	• Historical data and estimate BOD_5/COD ratio • Literature data • Electronic databases • MSDS information
Toxic effects / Inhibition	• Historical data • Literature data/QSAR • Electronic databases • MSDS information
Bioaccumulation	• Historical data • Literature data/QSAR • MSDS information
Receiving Environment	• Identify receiving environment • Relevant Water Quality Standards • Dilution /distribution in the receiving water

Note 1: Information may be available from similar wastewaters and/or single substances present in the wastewater of interest.

3. SITE VISIT

3.1 GENERAL

Having carried out the Desk Study it is important to carry out a site visit to ensure that an applicant has not overlooked something; the visit also provides the licensing authority with the opportunity to review the operation and maintenance procedures on-site.

The site visit should include a meeting with the applicant to discuss the application for a discharge licence/consent. The processes on the site generating the wastewater, the wastewater treatment plant (if applicable) and the discharge point(s) should be inspected. Details of wastewater volumes and how these figures were calculated should be examined. Where the wastewater undergoes treatment on-site prior to discharge to the local authority sewer or to a water body, the management of this facility should be reviewed. This review would cover the staffing, resources committed to the treatment plant, maintenance management (including corrective action programmes), record keeping, sampling and laboratory testing.

The inspection of processes generating the wastewater can be divided into two broad categories, indoor and outdoor processes. Indoor processes would include:

- water treatment plants;
- air conditioning and central heating systems; boilers; and
- elements of the wastewater treatment plant.

Outdoor processes would include:

- car and truck wash facilities;
- cooling towers; and
- elements of the wastewater treatment plant.

As discussed above the wastewater outfall point to waters and/or to foul sewer should be inspected. The dispersion of the discharged wastewater in the receiving water should be noted. It may be necessary to require the applicant to inspect the internal drainage to ensure its integrity.

The environmental impact of firewater and the possible requirement for fire water retention facilities should be assessed. Where such retention facilities exist, the adequacy of same should be investigated in addition to the outfall arrangements.

Finally, the bulk liquid storage facilities on-site should be examined and the bunding arrangements assessed (including its integrity).

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4. PHYSICO-CHEMICAL TESTS

4.1 GENERAL

The large number of substances which may be present in a wastewater make it very difficult (if not impossible for some wastewater streams) to recommend a general list of parameters which should be determined. Where it is possible to establish the concentration of the individual substances present in a wastewater discharge this is desirable. However, for **all** wastewater streams regardless of the receiving environment, the following chemical analyses should be performed:

- BOD_5;
- COD;
- TSS;
- pH;
- Conductivity;
- Temperature;
- Total phosphorus;
- Total nitrogen;
- Oils, fats and grease; and
- Detergents.

In addition, flow should be measured over a representative discharge period.

In Appendix A, Group B contains a list of parameters which should be used as an initial guide as to what substances may be present in an industrial wastewater stream. If it can be established that any of the parameters are likely to be present in significant concentrations, physico-chemical analysis of the parameters should be carried out in addition to the parameters mentioned above. For example for the electroplating industry, the additional parameters which may need to be considered are List I substances, organohalogens, phenols, mineral oil, cyanides and the heavy metals mercury, nickel, silver, lead, chromium, cadmium, tin, and copper.

4.2. SAMPLING WASTEWATER DISCHARGES

4.2.1 General

A wastewater characterisation programme, including physico-chemical analysis and ecotoxicological testing, will help to predict environmental hazards of complex effluents. The reliability of information obtained depends on the sampling and test methods employed. Prior to commencing a sampling programme, the laboratory carrying out the analysis should be contacted to ensure that sufficient volumes of wastewater are collected.

It is important that correct sampling protocols are followed to ensure that reliable results can be obtained from the characterisation programme. Good practices include the following:

- the sample collected should always be representative of the wastewater which is the subject of the study;
- proven sampling techniques have to be used; samples have to be preserved properly or analysed immediately depending on the parameter type; and
- samples must be correctly labelled on-site with all relevant sampling details.

4.2.2 Obtaining Representative Samples

The first requirement in wastewater sampling is to obtain a sample which is truly representative of the wastewater stream. A single "grab" sample collected at random may give results which do not reflect the true composition of the wastewater. Factors giving rise to variations include:

- flows can vary widely in magnitude and composition over a 24 hour period; and
- composition can vary within a given stream at any single time due to a partial settling of suspended solids or the floating of light materials.

To overcome these difficulties, the following practices are usually recommended:

- the wastewater must be adequately mixed to provide a truly representative sample; and
- composite samples should be taken over a period of up to 24 hours at appropriate intervals to account for variations in flow and wastewater.

It is essential to understand the wastewater flows in the plant in order to plan for where and when the composite samples are collected. Flow proportional samples are more likely to represent the true composition of the wastewater.

4.2.3 Sampling Techniques

The two most common types of sample collection are grab samples and composite samples; factors to be considered include, variability of the source, and the need or nature of the programme. These samples may be obtained either manually or automatically; details of automatic samplers have been outlined elsewhere (EPA, 1996).

4.2.3.1 *Grab Samples*

In general, a sample collected at a particular time and place can represent only the composition of the source at that time and place. However, when a source is known to be fairly constant in composition over a considerable period of time or over substantial distances in all directions, then the sample may represent a longer time period or a larger volume (or both) than the specific point at which it was collected.

Where a wastewater is known to vary with time, grab samples collected at suitable intervals and analysed separately can document the extent, frequency and duration of these variations. Sampling intervals should be chosen on the basis of frequency with which changes may be expected. These may vary from as little as 5 minutes to as long as 1 hour or more.

Grab samples should be used for pH, temperature, cyanides, total phenols, residual chlorine, oils, fat, grease, and faecal coliforms. These determinations have to be made as soon as possible after collection. It should be noted that composite samples for these determinands are not suitable.

4.2.3.2 *Composite Samples*

In order to minimise the number of samples to be analysed, it is usually desirable to mix several individual samples. A composite sample refers to a mixture of grab samples collected at the same sampling point at different times, which is commonly referred to as "time-composite". This method of sampling is useful for observing average concentrations, for example, in calculating the loading or the efficiency of a wastewater plant. A composite sample representing 24 hours is considered standard for most applications. Under certain circumstances, however, a composite sample representing one shift, or a complete cycle of a periodic operation, may be preferable. Time composite samples should only be used for determining components that can be demonstrated to remain unchanged under the conditions of sample collection and preservation.

4.2.4 Sample Handling

The collection vessel should be made of chemically inert materials and be of a size suitable for the respective test methods. The vessel should be rinsed several times with the wastewater before the sample is taken. Where possible this vessel should be fitted with a cooling device or be kept in a refrigerator. For standard tests, polyethylene vessels are recommended. If volatile compounds are present in the sample, glass or stainless steel vessels are used. Any specific requirements contained in the applicable analytical methods should be followed for sample containers, sample preservation, sample treatment, holding times, the collection of duplicate samples etc.

4.2.5 Sample Labelling

Clear, unambiguous sample labelling is critical to the receiving analytical laboratory. Sample(s) should be clearly labelled and the following information should be noted:

- sample source (and sub-source if necessary);
- sample type;
- name of individual taking the sample;
- date of sample; and
- time of sampling.

Where a number of samples are being taken for a variety of tests at the same location, these should be clearly linked (i.e. routine chemistry, microbiology, organics, metals analyses etc.).

5. BIOLOGICAL/ADVANCED PHYSICO-CHEMICAL TESTS

5.1 INHIBITION OF WASTEWATER TREATMENT MICROORGANISMS

In cases where industrial wastewater is being discharged to a wastewater treatment plant it is important to examine the risks (toxicity / inhibition) of the discharge towards the recipient microorganisms. In general, inhibition tests assess the inhibition of activated sludge microorganisms using:

- a respiration assay; and/or
- nitrification assay (using individual chemicals or mixtures).

Details of the inhibitory effect of selected chemicals on the activated sludge process are given in Table 3 below.

When an anaerobic waste treatment plant is receiving the wastewater (or excess sludge from an aerobic plant) it is preferable to perform these tests under anaerobic conditions using anaerobic bacteria. A schematic representation of such a test procedure is outlined in Figure 5.

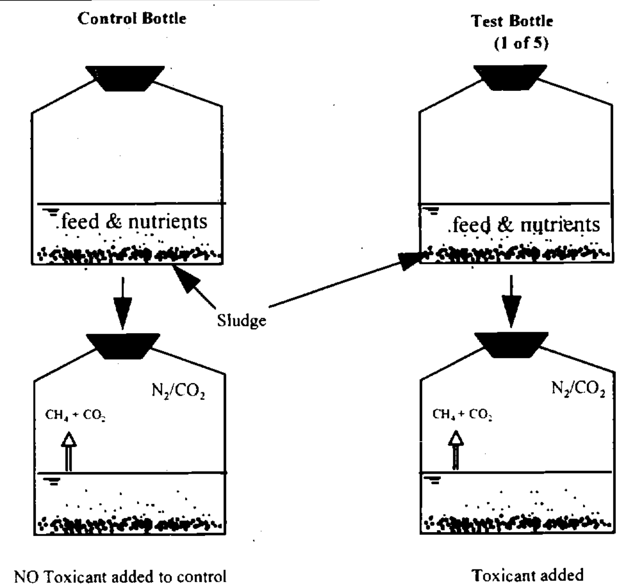
TABLE 3 REPORTED INHIBITION THRESHOLD LEVELS TO ACTIVATED SLUDGE

Substance	Inhibition threshold for activated sludge, mg/l	Substance	Inhibition threshold for activated sludge, mg/l
Cadmium	1-10	Ammonia	480
Total Chromium	1-100	Iodine	10
Chromium III	10-50	Sulphide	25 - 30
Chromium VI	1	Anthracene	500
Copper	1	Benzene	100-500
Lead	0.1-5.0, 10-100	2-Chlorophenol	5
Nickel	1.0-2.5	Ethylbenzene	200
Zinc	0.3-5.0	Pentachlorophenol	0.95, 50
Arsenic	0.1	Phenol	50-200,
Mercury	0.1-1, 2.5 as Hg(II)	Toluene	200
Silver	0.25-5.0	Surfactants	100-500
Cyanide	0.1-5		

(WEF, 1994)

Anaerobic Toxicity Assay

- Add sludge, feed(acetate), nutrients, buffer, feed to bottles;
- Flush headspace with N_2/CO_2 to establish anaerobic conditions;
- Add toxicant at various concentrations to a series of bottles (except control bottle);
- Monitor % CH_4 in headspace over an 8 hour period. % CH_4 generally decreases with increased toxicant concentration.



Calculations

- Determine ACT (rate of methane producing activity) in all bottles
- Determine % activity of control for all bottles

3-NP conc. (mg/l)	Rate of methane production[1]	% Activity of control
0	725	100
5	688	95
10	450	62
20	297	41
50	80	11
100	29	4

[1] Units are expressed in mgCH4-COD/g VSS/d.

- Inhibition %I = 100 - % ACT.

Calculate IC_{50} as per opposite figure

Effect of 3-Nitrophenol on Anaerobic Sludge

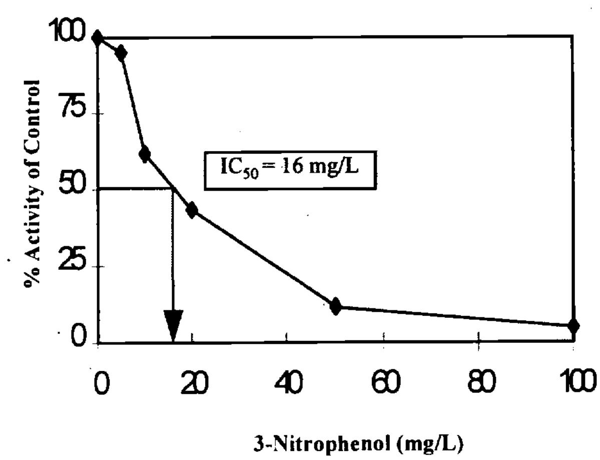


FIGURE 5 EXAMPLE OF AN ANAEROBIC TOXICITY ASSAY

5.2 AQUATIC TOXICITY TESTING

The control of wastewater discharges and the protection of aquatic life has traditionally relied on the monitoring of the discharged wastewater for a range of physical and chemical parameters. This approach has a number of limitations and is considered inadequate in the control of industrial wastewater discharges for the following reasons:

- it is not possible to limit and control all chemicals present in a particular wastewater;
- by-products, intermediates and contaminants produced during industrial processes are not considered; and
- interactive toxicity between chemicals (e.g. additivity, antagonism, synergism) cannot be controlled by setting limits for individual substances.

To overcome the above inadequacies, local authorities should where appropriate, request aquatic toxicity monitoring of wastewater emissions to water/sewer. Thus, the application of toxicity monitoring in conjunction with the requirement for testing of the chemical and physical constituents of the wastewater, should afford a safeguard against the presence of unknown or unanticipated contaminants that are harmful to aquatic life.

Toxicity tests use living organisms in order to determine toxic effects of individual substances or mixtures. There are three principal parameters involved in toxicity tests:

- the toxic effect monitored;
- the concentration and exposure; and
- the test organism.

The toxic effect monitored on the test organism is broadly classified into impaired survival or sub-lethal effects (reproduction, growth, and physiology). Other effects which may occur include:

- reduced swimming ability;
- alterations in pigmentation;
- abnormal mucous production;
- hyperventilation;
- bleeding;
- altered behaviour; and
- reduced food up-take.

Toxic effects can be classified by the duration of the test and this depends on the life cycle of the test organism. *Acute toxicity* results refer to exposure for a short duration of the life cycle of the test organism, such tests include:

- 48/96 hour lethal effects on crustaceans and fish; and
- Microtox test which is a 5-30 minute inhibition of light emission in *Vibrio fischeri.*

Chronic toxicity monitors the exposure over a significant part of the life cycle of the test organism. Chronic toxicity tests tend to monitor sub-lethal effects but and may extend to 10% of lifetime or more (even to mortality). The choice of test organism is of vital importance.

When characterising a wastewater using aquatic toxicity tests an initial toxicity screen test should be undertaken against species from different trophic levels (e.g. bacteria, plants/algae, crustacean, fish). When deciding what species to test against, particular reference should be made to the salinity of the receiving water system (i.e. freshwater, seawater). Having identified the most sensitive species using the screen test(s), all future compliance monitoring should be carried out on the two most sensitive species and both results (expressed as Tu) should be reported. In most cases testing will be carried out on a 24 hour flow proportional composite sample but where wastewaters are highly unstable in composition and in the absence of sufficient balancing, variations may occur. Hence, in order to address the vital consideration of wastewater stability and rather than collect the sample over a number of days it may be necessary to undertake testing on several consecutive 24 hour composite samples. To assist the evaluation of toxicity results, a physico/chemical analysis should also be carried out on the samples which are collected for the toxicity tests. In particular, as a guide to choosing the most appropriate concentration range and test species to be used in the assay, the levels of ammonia and salinity should be determined.

Toxicity/inhibition tests are carried out by exposing a group of test organisms in a series of dilutions of the test substance or mixture, under conditions which are controlled (as outlined above). On the basis of the recorded effect frequencies in the various dilutions, the effect concentrations (EC and LC) are usually calculated for the 10, 50, and 90% mortality or effect level in the population.

Table 4 outlines a list of species which may be suitable for toxicity testing. However, some of the species listed may not be available at all times during the year. Where it is proposed to conduct these tests, a proven and/or accredited laboratory should be engaged.

For the purposes of evaluating the information collected during the literature review (desk study) substances can be classified according to their aquatic toxicity as follows:

- highly toxic (EC_{50}, IC_{50} or LC_{50} <1mg/l);
- medium toxicity (1mg/l < EC_{50}, IC_{50} or LC_{50} < 100 mg/l); and
- low toxicity (EC_{50}, IC_{50} or LC_{50} > 100 mg/l).

The units here (mg/l) should not be confused with Tu units, the latter units are used to report the results of aquatic toxicity tests (outlined above). The following example sets out the background to Tu units:

if the results from a 24-hour EC_{50} toxicity test is 20% v/v, this means that 200 ml of wastewater made up to a litre with water had a specified effect on 50% of the test species, in 24 hours. To avoid

TABLE 4 SUGGESTED SPECIES FOR MONITORING WASTEWATER TOXICITY

		Receiving Environment	
Test Species	Freshwater	Estuarine or Coastal Water	Treatment Plant
Bacteria	*Vibrio fischeri*	*Vibrio fischeri*	*Vibrio fischeri, Activated sludge (inhibition of respiration, nitrification)* *Anaerobic Sludge (inhibition of CH_4 & CO_2 production)*
Crustaceans	*Daphnia magna (water flea)* *Brachionus calyciflorus (rotifer)*	*Tigriopus brevicornis (copepod)* *Brachionus plicatilis (rotifer)* *Crangon crangon (shrimp)*	*Daphnia magna*
Fish	*Oncorhynchus mykiss (rainbow trout)*	*Pleuronectes flesus (flounder)* *Scophthalamis maximus (turbot)*	
Plants/Algae	*Lemna minor(plant) Chlorella vulgaris (alga) Selenastrum capricornutum (alga)*	*Skeletonema costatum (alga)*	*Lemna minor Chlorella vulgaris Selenastrum capricornutum*

confusion and to report increasing toxicity with a correspondingly increasing number (i.e. the more toxic the wastewater, the higher the numerical Tu number assigned to it), the result is expressed as a function of the undiluted sample (100%). This form of expression is known as the Toxic Unit (Tu) and is defined as follows:

$$Tu = \frac{100}{EC_{50}}$$ **EQUATION 1**

In this example the wastewater had a toxicity of 5 units (Tu).

Where the wastewater is identified as being highly toxic, a TIE/TRE *(Toxicity Identification Evaluation/Toxicity Reduction Evaluation)* programme such as that developed by the US EPA (Rand, 1995) may be employed to identify the toxic elements in the wastewater stream and the corrective action(s) necessary to reduce or eliminate toxicity. A major component of the TRE is the TIE in which toxicity tests are combined with chemical analyses to identify and confirm causative toxicants. A TRE is designed on a site-specific basis and is conducted in a step-wise fashion to narrow the search for effective wastewater toxicity control measures.

5.3 BIOACCUMULATION TESTS

Bioaccumulation refers to the increased concentration of a substance in an organism relative to their environment and first came to prominence in the 1960s when it was discovered that high concentrations of DDT, DDD and methyl mercury were found in fish and fish eating birds. As one moved up trophic levels the DDT levels increase (i.e. crustacean → fish → birds). Other well known examples of bioaccumulative substances are PCB, hexachlorobenzene, heavy metals such as mercury, lead and cadmium and many organic metal complexes (organotin compounds).

Several interrelated terms are used in discussions about bioaccumlation tests. If the uptake occurs in the aquatic organism, this is called *bioconcentration.* Increased concentrations via food, at higher trophic levels in the food web is referred to as *biomagnification.*

Bioacculumation studies in water are usually carried out by assessing the uptake of a substance in contaminated water. If a constant level (of the substance under study) is reached in an organism (steady state), the *bioconcentration factor* (BCF) for the substance can then be determined. The BCF is a quantitative estimate of the capacity for bioaccumulation of a substance and is the ratio of the concentration in the organism to the concentration in the water.

The determination of BCF for a substance by means of a biological test demands relatively extensive efforts and as a result other approaches are normally used. It has been found that there is good correlation between the BCF value for an organic substance and its partition coefficient (P) in a two phase liquid system. Since P may be determined with relative ease (as the ratio between the concentration in a non-polar solvent and the concentration in a polar solvent at equilibrium in a two-phase system), the BCF can also be calculated. P is usually determined in a two-phase system n-octanol/water (P_{ow}).

Table 5 lists a number of correlations that have been determined for various groups of substances using fish.

TABLE 5 EXAMPLES OF CORRELATIONS BETWEEN BCF AND N-OCTANOL/WATER PARTITION COEFFICIENT (P_{ow}) FOR VARIOUS GROUPS OF SUBSTANCES

Substance group	Regression	Correlation (r)
Chlorohydrocarbons and PAHs	$\log BCF = 0.95 \times \log P_{ow} - 1.06$	0.99
Different organic substances	$\log BCF = 0.94 \times \log P_{ow} - 1.19$	0.89
Hydrocarbons and chlorohydrocarbons	$\log BCF = 0.98 \times \log P_{ow} - 1.36$	0.90
Aromatic substances	$\log BCF = 0.71 \times \log P_{ow} - 0.92$	0.98

In general, a BCF ≥ 100 for fish or log P_{ow} ≥ 3 has been suggested as a criterion for bioaccumulation.

The above tests primarily apply to specific organic substances. Where complex mixtures are concerned thin layer chromatography and/or gas chromatography may be required to separate the most lipophilic (water repellent) substances and assessing these as potentially bioaccumulating substances. In the example shown in Figure 6, it can be clearly seen that after the mixture has been separated (by thin layer chromatography), it consists of different substances which bioaccumulate to varying degrees.

In some cases where there is a large level of uncertainty about the bioaccumulating substances, it may be necessary to use the resultant end products of biodegradation for bioaccumulation tests. In general, however, bioaccumulating studies are complex to perform and, hence, other sources of information such as material and safety data sheets are typically used to assess the probability that a wastewater discharge will lead to bioaccumulation in the receiving environment.

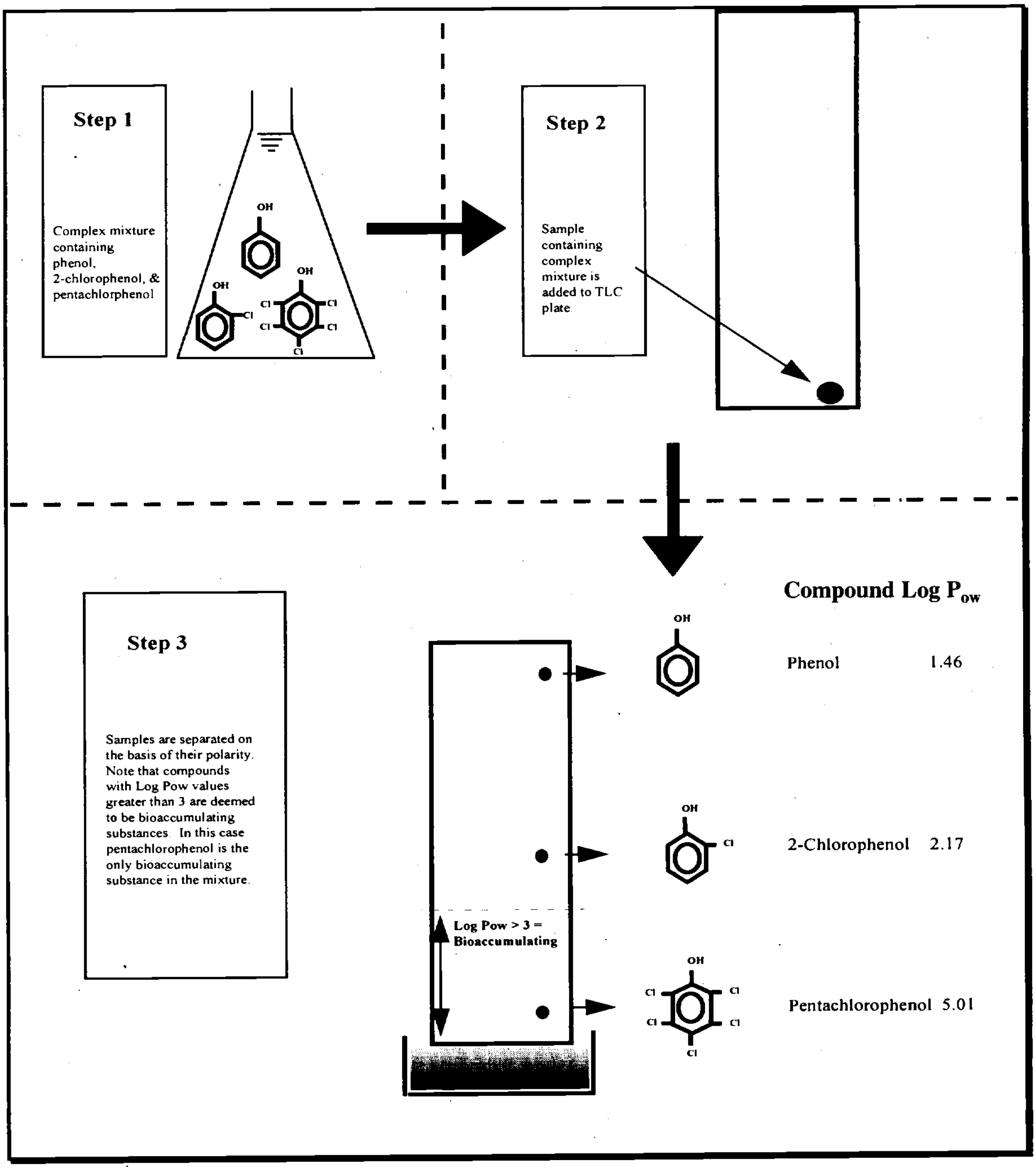


FIGURE 6 SCHEMATIC REPRESENTATION OF PARTITIONING OF SELECTED AROMATIC COMPOUNDS USING THIN-LAYER CHROMATOGRAPHY

5.4 BIODEGRADATION

Biodegradability is defined as the ability of a substance to undergo biodegradation. Biodegradation is the molecular degradation of a substance, resulting from the complex action of living organisms. The biodegradability of a wastewater is important as this can be used to assess the persistence of a chemical substance in the environment which may be the receiving water or a wastewater treatment plant. A distinction should be drawn between:

- *primary degradation,* which involves a loss by the substance/substances of its/their original structure;
- *functional degradation,* which involves the disappearance of certain significant properties, e.g. toxicity; and
- *ultimate degradation,* which is the complete breakdown of a substance either fully oxidised or reduced, to simple molecules (e.g. CO_2, H_2O, NO_3, NH_3, CH_4) and formation of new cells.

It should be noted that, the process of degradation normally results in a reduction of ecological risk associated with the substance. However, in some cases, the degraded product can be of a greater ecological risk. In addition, bio-elimination of the substance may occur and this should not be considered as degradation. Bio-elimination leads to the removal of the substance from the liquid phase, of a test substance in the presence of living microorganisms by physico-chemical as well as biological means. A typical example of bio-elimination would be the adsorption of a substance onto sludge in a wastewater treatment plant. This may result in the removal of the substance from the wastewater stream but accumulation in the sludge.

5.4.1 Assessment of Biodegradation under Aerobic Conditions

The factors influencing the biodegradability of a substance under aerobic conditions include:

- oxygen concentration, 1 mg/l is normally the minimum;
- concentration of the test substance, higher concentrations are generally more toxic and may inhibit the breakdown process;
- pH, generally biodegradability is higher at pH values 6-8;
- nutrients, trace elements and vitamins, these are required to sustain cell growth;
- temperature, biodegradability increases with temperature;
- particles and available surface, substances with low solubility have a tendency to adsorb to particles and surfaces thereby influencing the rate of biodegradation; and
- other organic substances, some substances will only degrade in the presence of other substances.

The initial information about the degradability of a wastewater stream may often be limited to the BOD_5/COD ratio, however, for complex wastewater streams it is important that this ratio is assessed in conjunction with individual substances in the wastewater stream. The normal BOD_5/COD ratio for a degradable industrial wastewater stream is above 0.43, though for complex wastewater streams substances may still persist which are not readily biodegradable.

There are many tests available for assessing the biodegradability of substances and mixtures. However, the OECD has endeavoured to standardise a number of test methods and these should be adopted. A screening procedure has been developed to assess the degradability of a substance after a predetermined period of time, taking into account the conditions in the chosen test system.

A rough classification of the biodegradability of a substance is:

- readily degradable (> 70% of dissolved organic carbon in *unfavourable* test methods);
- potentially/inherently degradable (20 - 100% in *favourable* test methods)
- not readily degradable or persistent (less than 20% in *favourable* test methods).

The term *readily degradable* is used for substances which are degraded significantly using test methods which are relatively unfavourable to biodegradation. Unfavourable conditions for biological degradation are reflected in a low ratio between biomass concentration (10^2-10^6 cells/ml) and the test substrate (2-100 mg/L). The test period is also short.

Test methods which are **unfavourable** for degradation include:

- DOC Die Away Test (ISO standard);
- modified OECD Screening Test (OECD 301 E).
- modified Sturm Test (OECD 301B/ISO standard);
- Closed Bottle Test (ISO standard); and
- Manometric Respirometry (ISO standard).

The term *inherently degradable or potentially degradable* is applied to substances which are biodegraded in test systems **favourable** to biodegradation (high biomass, longer incubation period), such tests include:

- the modified Zahn-Wellens Test (302A); and
- the modified SCAS Test (302B).

The most appropriate test method will depend on the characteristics of the wastewater stream. Table 6 matches the test methods which are applicable to the different substances, for example where a substance in the wastewater stream is not very soluble, the DOC Die-Away or the Modified OECD Die-Away test are inappropriate.

5.4.2 Assessment of Biodegradability under Anaerobic Conditions

Under anaerobic conditions, a biodegradable chemical is broken down by a consortium of fermentative and methanogenic bacteria to yield methane (CH_4) and carbon dioxide (CO_2) as the end products. The determination of the difference in total gas (CH_4 and CO_2) produced by anaerobic sludge alone and by a sludge supplemented with a test chemical gives a simple and sensitive measurement of the chemical's potential to undergo anaerobic biodegradation under methanogenic conditions. Standard methods for the estimation of anaerobic biodegradability of substances have been prepared (ISO, 1994).

5.4.3 Simulation Tests

Substances which have been found to be readily degradable in the OECD test strategy are expected to rapidly degrade in natural aquatic environments. However, if the discharge concentration is high, areas with significant concentration may occur in the region around the discharge point. In this case it may be necessary to carry out a simulation test. In addition, substances which are inherently degradable are not necessarily degradable to any extent in natural environments (e.g. fresh water). In these cases also the rate and extent of substance degradability should be determined using test methods that mirror the environment into which the substances are discharged.

The principle behind simulation tests is that they use water, sediment, and/or aerobic/anaerobic sludge from the environment into which the substance is to be discharged as the seed for the degradation test. In addition, the test substance is added in realistic concentrations (sometimes using ^3H or ^{14}C-labelled preparations) and the temperature of the test is kept at the level found in the receiving water. Simulation tests give a more accurate measure of the rate of degradation of substances (e.g. OECD No. 303A).

TABLE 6 APPLICABILITY OF AEROBIC DEGRADABILITY TEST METHODS

Test Method	Analytical Method	Suitability for substances		
		poorly soluble	volatile	absorbing
DOC Die-Away	Dissolved organic carbon	✗	✗	
Mod. OECD Screening Die-Away Test	Dissolved organic carbon	✗	✗	
CO_2 Evolution (Sturm test)	Respirometry: CO_2 evolution	✓	✗	✓
Closed Bottle	Respirometry: dissolved O_2		✓	✓
Manometric Respirometry	Manometric respirometry: O_2 consumption	✓		✓

✗ Unsuitable test procedure ✓ Suitable test procedure

5.5 SUMMARY OF AVAILABLE TEST METHODS METHODS

A summary table of available biological and physico-chemical test methods is presented in Table 7 below.

TABLE 7 SUMMARY OF AVAILABLE TEST METHODS

Tests	**Test Method / Analytical Technique**		
Physico - Chemical Analysis	Group A parameters - Appendix A: pH, TSS, total N, total P, COD, BOD_5, temperature, oils, fats and grease, detergents, conductivity (and flow).		
Physico - Chemical Industry Specific Analysis	Group B parameters - Appendix A. Perform GC/MS, HPLC, AA, ICP analysis etc.		
Toxicity / Inhibition Effects			
Activated Sludge methods.	Determine IC_{50} using respiration and/or nitrification test		
Anaerobic Sludge	Determine toxicity of industrial wastewater or sludge from anaerobic plant (IC_{50}) using assay for the inhibition of methanogens.		
Aquatic Testing	Freshwater	Estuarine or Coastal water	Treatment plant
● Bacteria	*Vibrio fischeri*	*Vibrio fischeri*	*Vibrio fischeri*
● Crustaceans	*Daphnia magna*	*Crangon crangon* *Tigriopus brevicornis*	*Daphnia magna*
● Fish	*Oncorhynchus mykiss*	*Pleuronectes flesus* *Scopthalamis maximus*	
● Plants/Algae	*Lemna minor* *Chlorella vulgaris*	*Skeletonema costatum*	*Lemna minor* *Chlorella vulgaris* *Selenastrum capricornutum*
Bioaccumulation	TLC analysis of lipophilic substances on aerobic (or anaerobic) stabilised samples (persistent fraction)		
Biodegradation	Standard Biodegradation Test Methods (see Text) Simulation Tests		

Table 8 collates the information which can be obtained from the results of degradability, bioaccumulating and toxicity tests.

TABLE 8 CLASSIFICATION OF SUBSTANCES FROM BIOLOGICAL AND PHYSICO-CHEMICAL ANALYSIS

Parameter	**Classification**		
	High	**Medium**	**Low**
Degradation potential	> 70%	20% < x < 70%	< 20%
Bioaccumulative potential	Log $P_{ow} > 3$		Log $P_{ow} < 3$
Aquatic Toxicity	$EC_{50} < 1$mg/l	1mg/L < EC_{50} < 100 mg/l	$EC_{50} >$ 100mg/l

6. EVALUATING THE INFORMATION

6.1 GENERAL

The characterisation of wastewater (using the methodology outlined in Chapter 1) will aid the assessment of a wastewater discharge, and may assist in drafting licence conditions. The characterisation will identify:

- the presence of excessive quantities of substances which may adversely impact on the receiving water or treatment plant;
- the population equivalent (in BOD_5, COD and volume terms) of the wastewater. The impact on the receiving water or treatment plant can then be established;
- the presence or otherwise of dangerous substances. These will need to be eliminated or reduced to a minimum;
- the lack of nutrients (mainly phosphorus or nitrogen) which may affect the biological treatment process or the excess of nutrients which may affect the receiving water;
- the degradability of the wastewater;
- the toxicity and inhibitory effect of the wastewater stream, on the receiving water or wastewater treatment plant; and
- the potential for individual substances to bioaccumulate in the receiving environment.

To evaluate the data collected after the wastewater has been characterised, Table 9 provides a summary sheet which should be completed for discharges to receiving waters and Table 10 can be used for discharges to the local authority sewer.

6.2 CONSENT CONDITIONS

The discharge of wastewater from an activity is required to have:

- a section 4 licence (where the discharge is to groundwater or surface water) under the Water Pollution Acts, 1977-1990;
- a section 16 licence (where the discharge is to a public sewer) under the Water Pollution Acts, 1977-1990;
- an IPC licence under the Environmental Protection Agency Act, 1992; or

TABLE 9 SUMMARY EVALUATION SHEET FOR WASTEWATER DISCHARGING TO A RECEIVING WATER

Parameter	Result	Units (if applicable)	Test method employed or source of information (if applicable)
population equivalent (BOD_5, COD, Volume) of the discharge			
List I substances			
List II substances			
Treatability/biodegradability of the wastewater			
Toxicity of the wastewater			

a waste licence under the Waste Management Act, 1996.

As mentioned earlier, where an application for an Integrated Pollution Control licence (IPC) and/or a waste licence is made to the EPA and it is proposed to discharge the wastewater to a local authority sewer, the consent of the sanitary authority is required.

Appendix D contains a checklist of draft conditions which maybe appropriate to control discharges to local authority sewers. These draft conditions can also be amended for use in section 4 licences.

TABLE 10 SUMMARY EVALUATION SHEET FOR WASTEWATER DISCHARGING TO A LOCAL AUTHORITY SEWER

Parameter	Result	Units (if applicable)	Test method employed or source of information (if applicable)
Population equivalent (BOD_5, COD, Volume) of the discharge			
Design population equivalent of the municipal wastewater treatment plant			
Present loading (organic and hydraulic) of the treatment plant			
Volatile substances used in the industrial process			
List I substances			
List II substances			
Treatability/biodegradability of the wastewater			
Toxicity of the wastewater			

APPENDIX A: FORM FOR EMISSIONS TO SEWER, SURFACE WATER, or GROUNDWATER

A summary list of the emission points, together with maps, drawings and supporting documentation should be included. Details of all List I and List II substances listed in the Annex to EU Directive 76/464/EEC (as amended) and EU Directive 80/68/EEC, contained in any emission must be presented.

EMISSIONS TO SEWER OR SURFACE WATER
Emission Point:

Emission Point Ref. No:		
Location of connection to sewer (if applicable) :		Name of receiving water:
Grid Ref. (10 digit, 5E, 5N):		95%ile flow 99.5%ile flow

EMISSIONS TO GROUND
Emission Point or Area:

Emission Point/Area Ref. No:	
Emission Pathway: (borehole, well, percolation area, soakaway, landspreading, etc.)	
Location :	
Grid Ref. (10 digit, 5E,5N):	
Elevation of discharge: (relative to Ordnance Datum)	
Aquifer classification for receiving groundwater:	
Groundwater vulnerability assessment (including vulnerability rating):	
Identity and proximity of groundwater sources at risk (wells, springs, etc):	
Identity and proximity of surface waters at risk:	

Emission Details (applicable to emissions to sewer, surface water or groundwater):

(i) Volume to be emitted

Normal/day	m^3	Maximum/day	m^3
Maximum rate/hour	m^3		

(iii) Period or periods during which emissions are made, or are to be made, including daily or seasonal variations (start-up /shutdown to be included):

Periods of Emission (avg) ________ min/hr ________ hr/day ________ day/yr

(iv) pH and temperature (°C) should be reported. Variations in these parameters on a batch basis, daily or seasonal basis should be included:

pH	units pH	variations	units pH
Temperature	°C	Temperature variations	°C

EMISSIONS TO SEWER SURFACE WATER OR GROUNDWATER - Characteristics of the emission (1 table per emission point)

Emission point reference number :

GROUP A PARAMETERS

Parameter	Prior to pre-treatment				As discharged				% Efficiency
	Max. hourly average (mg/l)*	Max. daily average (mg/l)*	kg/day	kg/year	Max. hourly average (mg/l)	Max. daily average (mg/l)	kg/day	kg/year	
BOD_5									
COD									
TSS									
Total Nitrogen (as N)									
Total Phosphorus (as P)									
Oils, fats and grease									
Detergents (as MBAS)									
Conductivity (μS/cm)									

* except for conductivity

GROUP B PARAMETERS *(see next page for parameters)*

Parameter	Prior to pre-treatment				As discharged				% Efficiency
	Max. hourly average (mg/l)	Max. daily average (mg/l)	kg/day	kg/year	Max. hourly average (mg/l)	Max. daily average (mg/l)	kg/day	kg/year	

PARAMETERS OTHER THAN GROUP A PARAMETERS WHICH MAY BE PRESENT IN AN INDUSTRIAL DISCHARGE

Parameter Process	EC List I	Organo-halogens	Phenols	Mineral oil (interceptor)	Mineral oil (biological treatment)	Sulphide	Cyanides	Fluoride	Heavy Metals
Manufacture of chemicals[1]	x	x	x	x	x		x		Hg, Sn, Pb, Cr, Cd, Zn, Cu
Asbestos Glass Fibre Processing & Manufacture, Glass Production	x		x		x			x	As, Pb
Manufacture of ICB, PCB				x				x	Cr, As, Cu, Sn, Pb
Manufacture of vegetable and animal oils and fats				x	x				
Processing of iron and steel				x					Pb, Ni, Zn, Cr, Cu
Electroplating	x	x	x	x	x		x		Hg, Ni, Ag, Pb, Cr, Cd, Sn, Cu
Slaughtering				x					
Manufacture of synthetic fibres			x				x		
Dying, treatment or finishing of fibres textiles[2]	x	x	x	x	x	x			Cr, Hg, Co, Pb, Ni, As, Cd, Zn, Cu
Fellmongering of hides and tanning of leather	x		x	x		x			Cr
Metal, mining and mineral quarrying				x	x				Th
Operations involving coating with organo-tin compounds	x			x					organotin, Cu, many metals
Coarse ceramics (refractory bricks, stoneware pipes, facing and floor bricks and roof tiles)				x		x		x	
Melting or production of iron or steel	x			x					Cd, Hg, Pb, Zn, Cr, Ni
Production, recovery, processing or use of ferrous metals in foundries[3]	x		x	x					Cd, Hg
Rendering of animal by-products				x					
Production, recovery, or processing of non-ferrous metals	x			x					Ag, Ca, Cr, Cu, Hg, Ni, Sn, Zn
Manufacture of fish meal and fish oil				x					
Manufacture of dairy products				x	x				
Treatment or protection of wood with preservatives	x	x	x						As, Cr,
Roasting, sintering or calcining of metallic ores				x					Cd, Cu, Hg, Ni, Pb, Zn

Note 1. Other parameters which may be present include solvents such as benzene, toluene, xylene, or genetically modified organisms
Note 2. Also found: Benzene, toluene, xylene, pesticides
Note 3. Other parameters depending on resins and binders

DIRECTIVE 76/464/EEC LIST I AND LIST II SUBSTANCES

List I	List II
1. Organohalogen compounds and substances which may form such compounds in the aquatic environment.	1. The following metalloids and metals and their compounds: 1. Zinc; 2. Copper; 3. Nickel; 4. Chromium; 5. Lead; 6. Selenium; 7. Arsenic; 8. Antimony; 9. Molybdenum; 10. Titanium; 11. Tin; 12. Barium; 13. Beryllium; 14. Boron; 15. Uranium; 16. Vanadium; 17. Cobalt; 18. Thallium; 19. Tellurium; 20. Silver.
2. Organophosphorus compounds	2. Biocides and their derivatives not appearing in List I.
3. Organotin compounds	3. Substances which have a deleterious effect on the taste and / or smell of the products for human consumption derived from the aquatic environment, and compounds liable to cause the formation of such substances in water.
4. Substances which possess carcinogenic, mutagenic or teratogenic properties in or via the aquatic environment* ** Where certain substances in list II are carcinogenic, mutagenic or teratogenic, they are included in this category.*	4. Toxic or persistent organic compounds of silicon and substances which may give rise to such compounds in water, excluding those which are biologically harmless or are rapidly converted in water into harmless substances
5. Mercury and its compounds	5. Inorganic compounds of phosphorus and elemental phosphorus
6. Cadmium and its compounds	6. Non persistent mineral oils and hydrocarbons of petroleum origin.
7. Persistent mineral oils and hydrocarbons of petroleum origin	7. Cyanides, fluorides.
8. Persistent synthetic substances which may float, remain in suspension or sink and which may interfere with any use of the waters.	8. Substances which have an adverse effect on the oxygen balance, particularly ammonia, nitrites.

APPENDIX B: FORM FOR RAW MATERIALS, INTERMEDIATES AND PRODUCTS

A list of the raw and ancillary materials, substances, preparations, fuels and energy used in the activity should be completed.

The list(s) given should be comprehensive, all materials used, fuels, intermediaries, laboratory chemicals and product should be included.

Particular attention should be paid to materials and product consisting of, or containing, dangerous substances as described in the EU (Classification, Packaging, Labelling and Notification of Dangerous Substances) Regulations 1994 [SI 77/94]. The list must classify these materials in accordance with Article 2 of these Regulations, and must specify the designated Risk Phrases (R-Phrases) of each substance in accordance with Schedule 2 of the Regulations

DETAILS OF PROCESS RELATED RAW MATERIALS, INTERMEDIATES, PRODUCTS, ETC., USED OR GENERATED ON THE SITE.

Ref. No or Code	Material/ Substance[1]	CAS Number	Danger[2] Category	Amount Stored (tonnes)	Annual Usage (tonnes)	Nature of Use	Organic/	R[3] - Phrase	S[3] - Phrase	Seveso[4] Yes/No

Notes: 1. In cases where a material comprises a number of distinct and available dangerous substances, please give details for each component substance.
2. c.f. Article 2(2) of Statutory Instrument No 77/94
3. c.f. Schedules 2 and 3 of Statutory Instrument No 77/94
4. European Communities (Major Accident Hazards of Certain Industrial Activities) Regulations, 1992 (S.I. No. 21 of 1992)

DETAILS OF PROCESS RELATED RAW MATERIALS, INTERMEDIATES, PRODUCTS, ETC., USED OR GENERATED ON THE SITE.

Ref. No or Code	**Material/ Substance(1)**	**Ecological Aquatic**				**Toxicological**				**Radioactive**
		LC_{50} mg/l	Species EC_{50}[5]	mg/l	Species	Oral LD_{50} mg/kg	Species	IV LD_{50} mg/kg	Species	**Yes/No**

Notes (cont.): 5. Where available

DETAILS OF PROCESS RELATED RAW MATERIALS, INTERMEDIATES, PRODUCTS, ETC., USED OR GENERATED ON THE SITE.

Ref. No or Code	**Material/ Substance** (1)	**TA Luft* Class 1, 2 or 3**	**Odour**			**EU Lists and II (Tick and specify Group/Family Number)**			
			Odourous Yes/No	Description	Threshold $\mu g/m^3$	Dangerous Substances Directive 76/464/EEC		Groundwater Directive 80/68/EEC	
						List I	List II +129 (5)	List I	List II

Notes (cont.): 6. The European Commission priority candidate list

*TA Luft - Technical instructions on Air Quality Control

APPENDIX C: CALCULATIONS

DILUTION RATE

$$\text{No of dilutions available in the receiving water} = \frac{\text{flow in the receiving water * } (\text{m}^3\ \text{day})}{\text{discharge volume } (\text{m}^3\ \text{day})}$$

* The water quality management plan should be consulted to establish whether the 95%ile or 99.5%ile flow figure should be used.

ASSIMILATION CAPACITY

To estimate the assimilation capacity in a freshwater river, the following formula may be used:

$$\text{Assimilation capacity (AC) in kg BOD} \cdot \text{day} = (C_{max} - C_{back}) \times F_{95} \times 86.4$$

Where:

C_{max} = maximum permissible BOD_5 concentration in the receiving water (usually 4 mg/l)

C_{back} = the background (upstream) BOD_5 concentration (mg/l)

F_{95} = 95% flow (m^3/s) (The water quality management plan should be consulted to establish whether the 95%ile or 99.5%ile flow figure should be used)

86.4 adjusts for the different units and converts the load to a daily figure

BOD_5 LOADING, Kg/day

$$\text{BOD loading kg/day} = \frac{(\text{mg/l BOD}_5)(\text{m}^3/\text{d flow})}{1000}$$

COD LOADING, Kg/day

$$\text{COD loading kg/day} = \frac{(\text{mg/l COD})(\text{m}^3/\text{d flow})}{1000}$$

POPULATION EQUIVALENT

$$\text{Population Equivalent (BOD)}^1 = \frac{\text{kg / day BOD}}{0.06}$$

$$\text{Population Equivalent (COD)}^1 = \frac{\text{kg / day COD}}{0.3}$$

$$\text{Population Equivalent (VOLUME)} = \frac{\text{m}^3\text{ / day Volume}}{0.18}$$

[1]Based on the BOD_5/COD ratio (25/125) in the Environmental Protection Agency Act, 1992 (Urban Wastewater Treatment) Regulation, 1994. Where the BOD_5/COD ratio differs from the ratio, this formula may need to be revised.

APPENDIX D: DRAFT CONSENT CONDITIONS FOR LICENCES

Name of Sanitary Authority:

Address:

Name of Facility:

Address:

GENERAL CONSENT CONDITIONS	**Condition to be included (Yes/No)**
1. No specified emission to sewer shall exceed the emission limit value set out in Schedule X Emissions to Sewer, subject to Condition XY of this licence. There shall be no other emission to sewer of environmental significance.	
2. Monitoring and analyses of each emission to the sewer shall be carried out as specified in Schedule XX Monitoring of Emissions to Sewer of this licence.	
3. Monitoring and analyses equipment shall be operated and maintained as necessary so that monitoring accurately reflects the emission or discharge.	
4. No substance shall be present in such concentrations as would constitute a danger to sewer maintenance personnel working in the sewerage system or would be injurious to the construction of sewer or would interfere with the operations of a downstream wastewater treatment works.	
5. No substance shall be discharged in a manner, or at a concentration, which causes tainting of fish or shellfish.	
6. The licensee shall permit authorised persons of the licensing authority (and/or the Sanitary Authority) to inspect, examine and test, at all reasonable times, any works and apparatus installed in connection with the trade effluent and to take samples of the trade effluent.	
7. No emission to sewer shall take place which gives rise to any reaction within the sewer or to the liberation of by-products which may be of environmental significance.	
8. The licensee shall ensure that the effluent shall not contain petroleum spirits or organic solvents (including chlorinated organic solvents) which would give rise to flammable or explosive vapours in the sewer.	
10. A summary report of the results of analysis of effluent discharged to the sewer shall be forwarded to the sanitary authority on a ___________ basis (specify frequency).	

GENERAL CONSENT CONDITIONS continued	**Condition to be included (Yes/No)**
11. A log detailing the usage of all cooling water and boiler water treatment chemicals shall be kept by the licensee and submitted to the sanitary authority on a ____________ basis (specify frequency).	
12. Non-trade effluent wastewater (e.g. firewater, accidental spillage) which occurs on-site shall not be discharged to the sewer without the prior authorisation of the sanitary authority.	
13. The licensee shall provide and maintain an inspection chamber in a suitable position in connection with each pipe through which the trade effluent is being discharged. Each such inspection chamber or manhole shall be constructed and maintained by the licensee so as to permit the taking of samples of the discharge.	
15. The acute toxicity of the undiluted final effluent to at least four aquatic species from different trophic levels shall be determined by standardised and internationally accepted procedures and carried out by a competent laboratory. The name of the laboratory and the scope of testing to be undertaken shall be submitted, in writing, to the Licensing authority, within 3 months of the date of grant of this licence. Once the testing laboratory and the scope of testing have been agreed by the Licensing authority, the Licensing authority shall decide when this testing is to be carried out and copies of all reports shall be submitted by the licensee to the Licensing authority within six weeks of completion of the testing.	
16. Having identified the most sensitive species outlined in Condition 15, subsequent compliance toxicity monitoring on the two most sensitive species shall be carried out by the laboratory identified in Condition 15 as per Schedule XX Emissions to Water/Sewer. The Agency shall decide when this testing is to be carried out and copies of all reports shall be submitted by the licensee to the Agency within six weeks of completion of the testing.	
17. The licensee shall at no time discharge or permit to be discharged into the sewer any liquid matter or thing which is or may be liable to set or congeal at average sewer temperature or is capable of giving off any inflammable or explosive gas or any acid, alkali or other substance in sufficient concentration to cause corrosion to sewer pipes, penstock and sewer fittings or the general integrity of the sewer.	
18. Any surface water arising from areas where barrels or containers are stored or washed shall be discharged to a sump. This effluent may be discharged to the sewer if it does not exceed emission limit values specified in Schedule X.	

LIMIT VALUES FOR TRADE EFFLUENT TO SEWER

SCHEDULE X - EMISSIONS TO SEWER

Emission Point Reference No: _______

Emission to (sewer description): ____________________

Volume to be emitted : Maximum in any one day : ____________ m^3

Maximum rate per hour : ____________ m^3

Parameter (delete parameters which are not applicable)	**Emission Limit Value**			**Parameter to be limited**
	Grab Sample (mg/l)	**Daily Mean Concentration (mg/l)**	**Daily Mean Loading (kg/day)**	**(Yes/No)**
BOD_5				
COD				
Suspended Solids				
Sulphates (as SO_4)				
Detergents (as MBAS).				
Fats,.Oils, Grease				
pH				
Temperature				
ADDITIONAL PARAMETERS (if required)				

FREQUENCY OF MONITORING TRADE EFFLUENT TO SEWER

Schedule XX - Monitoring of Emissions to Sewer

Emission Point Reference No:___________________

Parameter (delete parameters which are not applicable)	**Monitoring Frequency**	**Sampling Method/Type** (grab, continuous)
Flow to sewer		
BOD_5		
COD		
Suspended Solids		
Sulphates (as SO_4)		
Fats, Oils, Grease		
Detergents (as MBAS)		
Temperature		
pH		
ADDITIONAL PARAMETERS (if required)		

SANITARY AUTHORITY CHARGES	
Charge per cubic metre of trade effluent / per kg of BOD_5 (delete as appropriate)	
Payment Frequency	
Annual Monitoring Costs	

NOTES:

Other general conditions may include;

(a) The licensee shall notify the sanitary authority of any incident with the potential for environmental contamination of surface water or groundwater, or posing a threat to land, or a sanitary authority sewer or personnel working in connection with a sewer, or requiring an emergency response by the local authority.

(b) The licensee shall notify the local authority as soon as is practicable, after the occurrence of any one of the following;

(i) any incident with the potential for environmental contamination of surface water or groundwater, or posing a threat to land, or a Sanitary Authority sewer or personnel working in connection with a sewer, or requiring an emergency response by the local authority
(ii) any emission which relates to a discharge to sewer which does not comply with the requirements of this licence.

(c) Emission limits for emissions to sewer shall be interpreted as follows (Condition XY):-
For Continuous Monitoring:
No flow value shall exceed the specified limit.

For Non-Continuous Monitoring:
No pH value shall deviate from the specified range.
No temperature value shall exceed the emission limit value.
For parameters other than pH, temperature and flow, eight out of ten consecutive results, calculated as daily mean concentration or mass emission values on the basis of flow proportional composite sampling, shall not exceed the emission limit value. No individual result similarly calculated shall exceed 1.2 times the emission limit value.
For parameters other than pH, temperature, and flow, no grab sample value shall exceed 1.2 times the emission limit value.

(d) The licensee shall provide safe and permanent access to the final effluent as discharged to sewer.

(e) All automatic monitors and samplers shall be functioning at all times (except during maintenance and calibration) when the activity is being carried on unless alternative sampling or monitoring has been agreed in writing by the Licensing authority for a limited period. In the event of the malfunction of any continuous monitor, the licensee shall contact the Licensing authority as soon as practicable, and alternative sampling and monitoring facilities shall be put in place. Prior written agreement for the use of alternative equipment, other than in emergency situations, shall be obtained from the Licensing authority.

(f) The equipment, including backup equipment, specified in Schedule XXX Effluent Treatment Control of this licence, shall be provided on-site. All treatment/abatement, control and monitoring equipment shall be calibrated and maintained at all times when in use, in accordance with the information submitted during the licence application or as otherwise approved by the Licensing authority under the environmental management programme.

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USER COMMENT FORM

NOTE: Completed comments to be forwarded to: The Environmental Management and Planning Division, Environmental Protection Agency, Ardcavan, Wexford

Document Title: **Characterisation of Industrial Wastewater**

CONTENTS:

STYLE:

INFORMATION:

SUGGESTIONS FOR FUTURE EDITIONS:

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....

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Selected Environmental Protection Agency Publications

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Handbook on Urban Wastewater Treatment. *(1996)*	£15
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AN GHNÍOMHAIREACHT UM CHAOMHNÚ COMHSHAOIL

BUNÚ

Achtaíodh an tAcht fán nGníomhaireacht um Chaomhnú Comhshaoil ar an 23ú lá d'Aibreán, 1992 agus faoin reachtaíocht seo bunaíodh an Ghníomhaireacht go hoifigiúil ar an 26ú lá d'Iúil, 1993.

CÚRAIMÍ

Tá réimse leathan de dhualgais reachtúla ar an nGníomhaireacht agus de chumhachtaí reachtúla aici faoin Acht. Tá na nithe seo a leanas san áireamh i bpríomhfhreagrachtaí na Gníomhaireachta:

- ceadúnú agus rialáil próiseas mór/ilchasta tionsclaíoch agus próiseas eile a d'fhéadfadh a bheith an-truaillitheach, ar bhonn rialú comhtháite ar thruailliú (Integrated Pollution Control - IPC) agus cur chun feidhme na dteicneolaíochtaí is fearr atá ar fáil chun na críche sin:

- faireachán a dhéanamh ar cháilíocht comhshaoil, lena n-áirítear bunachair sonraí a chur ar bun a mbeidh rochtain ag an bpobal orthu, agus foilsiú tuarascálacha tréimhsiúla ar staid an chomhshaoil:

- comhairle a chur ar údaráis phoiblí maidir lena bhfeidhmeanna comhshaoil agus cuidiú le húdaráis áitiúla a bhfeidhmeannas caomhnaithe a chomhlíonadh:

- cleachtais atá fónta ó thaobh an chomhshaoil de a chur chun cinn, mar shampla, trí úsáid iniúchtaí comhshaoil a spreagadh, scéim éicilipéadaithe a bhunú, cuspóirí cáilíochta comhshaoil a leagan síos agus cóid chleachtais a eisiúint maidir le nithe a théann i bhfeidhm ar an gcomhshaol:

- taighde comhshaoil a chur chun cinn agus a chomhordú:

- gach gníomhaíocht thábhachtach diúscartha agus aisghabhála dramhaíola, lena n-áirítear líonaí talún, a cheadúnú agus a rialáil agus plean náisiúnta um dhramhaíl ghuaiseach, a bheidh le cur i ngníomh ag comhlachtaí eile, a ullmhú agus a thabhairt cothrom le dáta go tréimhsiuil:

- clár hidriméadach náisiúnta a ullmhú agus a chur i ngníomh chun faisnéis maidir le leibhéil, toirteanna agus sreabha uisce in aibhneacha, i lochanna agus i screamhuiscí a bhailiú, a anailísiú agus a fhoilsiú; agus

- maoirseacht i gcoitinne a dhéanamh ar chomhlíonadh a bhfeidhmeanna reachtúla caomhnaithe comhshaoil ag údaráis áitiúla.

STÁDAS

Is eagras poiblí neamhspleách í an Ghníomhaireacht. Is í an Roinn Comhshaoil agus Rialtais Áitiúil an coimirceoir rialtais atá aici. Cinntítear a neamhspleáchas trí na modhanna a úsáidtear chun an tArd-Stiúrthóir agus na Stiúrthóirí a roghnú, agus tríd an tsaoirse a dhearbhaíonn an reachtaíocht di gníomhú ar a conlán féin. Tá freagracht dhíreach faoin reachtaíocht aici as réimse leathan feidhmeannas agus cuireann sé seo taca breise lena neamhspleáchas. Faoin reachtaíocht, is coir é iarracht a dhéanamh dul i gcion go míchuí ar an nGníomhaireacht nó ar aon duine atá ag gníomhú thar a ceann.

EAGRÚ

Tá ceanncheathrú na Gníomhaireachta lonnaithe i Loch Garman agus tá cúig fhoireann chigireachta aici, atá lonnaithe i mBaile Átha Cliath, Corcaigh, Cill Chainnigh, Caisleán an Bharraigh agus Muineachán.

BAINISTÍOCHT

Riarann Bord Feidhmiúcháin lánaimseartha an Ghníomhaireacht. Tá Ard-Stiúrthóir agus ceathrar Stiúrthóirí ar an mBord. Ceapann an Rialtas an Bord Feidhmiúcháin de réir mionrialacha atá leagtha síos san Acht.

COISTE COMHAIRLEACH

Tugann Coiste Comhairleach ar a bhfuil dáréag ball cúnamh don Ghníomhaireacht. Ceapann an tAire Comhshaoil agus Rialtais Áitiúil na baill agus roghnaítear iad, den chuid is mó, ó dhaoine a ainmníonn eagraíochtaí a bhfuil suim acu i gcúrsaí comhshaoil nó forbartha. Tá réimse fairsing feidhmeannas comhairleach ag an gCoiste faoin Acht, i leith na Gníomhaireachta agus i leith an Aire araon.