DEVELOPMENTS IN INDUSTRIAL EFFLUENT CONTROL IN THE UNITED KINGDOM

T. J. Fisher

North West Water Limited, Dawson House, Great Sankey, Warrington, WA5 3LW, England

ABSTRACT

Since 1974 controls on industrial effluent dischargers in the United Kingdom have increased significantly. The Water Act 1989 transferred the Water Industry in England and Wales to the private sector and created a National Rivers Authority. A mechanism to control the input of dangerous and harmful substances into the aquatic environment was established which requires Water Service Companies (WSCs) to refer to the Secretary of State for the Environment before granting consents for discharge to public sewer.

The Environmental protection Act 1990 (EPA) further increased regulation and established the principle of Integrated Pollution Control (IPC). Operators of industrial processes listed under the Act are required to obtain authorisation from Her Majesty's Inspectorate of Pollution (HMIP) (HMIP in Scotland) before they can operate the process.

The complexity of legislation and regulation is described and practical difficulties experienced when implementing the controls are examined, as are the relationships between the main environmental regulators together with their relative responsibilities. Also discussed are the costs associated with licensing and effluent disposal.

KEYWORDS

Control; Cost; Environment; Dangerous Substances; Legislation; Regulation; Special Category Effluents.

INTRODUCTION

From the first mention of industrial effluent in United Kingdom law in the late nineteenth century, responsibility for control of discharges rested with Local Authorities. At first, control powers were limited and it was not until the Public Health Act 1936 and the Public Health (Drainage of Trade Premises) Act 1937 became law that effective control could be exercised over discharges to public sewer.

Prevention of pollution and control of discharges to rivers was the responsibility of River Authorities acting principally under the provisions of the Rivers (Prevention of Pollution) Acts of 1951 and 1961.

The Water Act 1989 transferred responsibility for water and sewerage services in England and Wales from public sector Water Authorities to private sector Water Service Companies (WSCs) and also created a National Rivers Authority (NRA) and Her Majesty's Inspectorate of Pollution (HMIP) (HMIP in Scotland). The Act also established the Director General of Water Services (DG) as a national regulator to oversee the
activities of the WSCs. Responsibility for provision of water services in Scotland and Northern Ireland is under review but currently remains in the public sector.

LEGISLATION

United Kingdom Law

In July 1991 Royal Assent was given to five New Acts of Parliament. Namely:

- Water Resources Act 1991
- Water Industry Act 1991
- Statutory Water Companies Act 1991
- Land Drainage Act 1991

These Acts, which came into force on 1 December 1991, replace, but do not materially alter, all previous water law in England and Wales. The Water Resources Act and the Water Industry Act give the NRA and WSCs respectively, powers to accept and control industrial discharges and to levy charges for reception and treatment. Regulations made under these Acts give statutory effect in UK law to European Community environmental legislation.

The Environmental Protection Act 1990 also has a significant impact on industry, introducing as it does the concept of Integrated Pollution Control (IPC). Processes in the most polluting industrial sectors must be authorised by HMIP before they can be operated. Control under the EPA is to be implemented according to a phased timetable. Operators of part A processes will be required to have applied for authorisation before 31 January 1996 and an industry-by-industry schedule for the implementation of control is included in regulations made under the Act.

Provision is made within the Act for HMIP to recover the cost of authorising and controlling processes by operation of a charges scheme.

EUROPEAN LAW

The European community has influenced pollution control to a considerable degree in recent years. Since 1973 more than 300 measures related to environmental protection have been agreed which in turn have a significant impact on the way in which member states determine environmental policy. Council Directives, although themselves not legally enforceable, require member states to incorporate measures at least as stringent within their national legislation. Of the Directives concerned with pollution control, that most likely to affect industrial effluent dischargers is the Dangerous Substances Directive 76/464/EEC which is supported by an annex grouping substances into two lists according to their toxicity, persistence and bioaccumulation. Member States are required to take steps to eliminate pollution by list I substances and to reduce pollution by list II substances. The Directive, given effect in the UK by The Surface Waters (Dangerous Substances) (Classification) Regulations 1989, is a framework directive and provides for the adoption of "Daughter" directives setting limit values and quality objectives for list I substances.

The Urban Wastewater Treatment Directive 91/271/EEC, although principally concerned with discharge of municipal wastewater, has provisions relating to industrial wastewater in requiring member states to ensure, before December 1993, that discharges of industrial wastewater into collecting systems and urban wastewater treatment plants are subject to regulation and/or authorisation by a competent authority or appropriate body. The directive sets standards for discharges from urban wastewater treatment works (WwTWs), including specified COD and BOD limits as well as total phosphorus and total nitrogen limits for treatment plants in "sensitive areas". In addition there is a requirement to control discharges from 11 listed
industrial sectors if the discharge is not made to a wastewater treatment plant. In the UK these discharges will be the responsibility of the NRA and for that reason are not considered here.

International Conventions, in particular the International Conference on the Protection of the North Sea, have also had a significant impact on pollution control in Member States surrounding the sea. The first Conference was held in Bremmen in 1984. At the second, held in London in November 1987, a Ministerial Declaration of actions to be taken to protect the North sea was made which the British Government extended to all coastal waters around the UK in order to apply a consistent approach. The declaration agreed that North Sea States would aim to make reductions of the order of 50% between 1985 and 1995 in the total inputs from rivers and streams of substances which are toxic and bioaccumulative. The UK agreed (inter alia) to adopt Best Technical Means Available (BTMA) to limit emissions to the aquatic environment and to set statutory water quality objectives.

The third international conference, held in the Hague in 1990, agreed measures for environmental improvements including:

- significant reductions for riverine and estuarine input of a list of 36 substances
- reductions "of the order of 70%" in substances which cause threat to the marine environment (e.g. dioxins, cadmium, mercury and lead)
- "substantial reductions" in pesticides reaching the North Sea
- phasing out the use of PCBs and hazardous PCB substitutes and
- bringing forward the target date for cessation of incineration at sea to the end of 1991

The fourth North Sea Conference will be held in Denmark in 1995.

It follows that, in order to comply with the above, reductions will be required in inputs from industrial sources either directly or via wastewater treatment works.

CONTROL AND REGULATION

Roles and Responsibilities

Since privatisation the water industry has become one of the most heavily regulated industries in the UK. Almost every aspect of the business is under the scrutiny of one or other of nine regulators concerned with finance, water quality and environment. Some of the regulators also have responsibilities in relation to industrial effluent discharge, the principal ones being The Secretary of State for the Environment, HMIP and the NRA.

Control of industrial effluent in the UK is now effectively a two-tier system. The EPA introduces a process-based system of control which includes regulation of releases to all three environmental media (land, air and water) whereas the Water Resources and Water Industry Acts allow for control of substances prescribed in regulations. Discharges can be made to either Controlled Waters (including rivers, sea, estuaries or underground) or to Public Sewer.

Controlled Waters. The NRA is the primary body responsible for control of discharges to controlled waters and has statutory duties under the Water Resources Act. It is not proposed to deal with those duties in this paper except in so far as they have a subsequent effect on discharges to public sewer.
Public Sewer. Control of industrial effluent discharges to public sewer is the responsibility of the WSCs using powers given under the Water Industry Act and to make a discharge without the consent or agreement of the WSC is not lawful. Any consent given or agreement made will contain conditions designed to provide an acceptable and secure service to the trader while at the same time protecting the WSC's interests and meeting its environmental obligations. The WSCs operate charging schemes designed to recover costs incurred in treatment and disposal and to provide an adequate return on capital employed. Details of the charging systems are given below.

HMIP have responsibilities in relation to both discharge routes. The Trade Effluent (Prescribed Processes and Substances) Regulations 1989 (as amended in 1991 and 1992), prescribe certain trade effluents for special control. These effluents, which are designated "Special Category Effluents", are those which contain:

- a prescribed substance (see Table 1) at a concentration above background concentration
- trichloroethylene or perchloroethylene in quantities constituting more than 30kg per year
- an effluent from a prescribed process where either chloroform or asbestos is present above background concentrations.

The regulations define "background concentration" as that concentration which would be present if the process was not (i.e. the concentration in mains water supply, abstracted river water or rainfall).

A WSC may not give consent to discharge or enter into an agreement to accept a discharge or vary an existing consent or agreement if that action would authorise a discharge of special category effluent, without first referring the proposal to the Secretary of State with the question "Should the discharge be permitted or should it be subject to any conditions?" The Secretary of State may also review whether an existing discharge of special category effluent should be prohibited or subject to conditions. In both cases HMIP acts on behalf of the Secretary of State in determining the referral.

### TABLE 1. Prescribed Substances (Water Act 1991)

<table>
<thead>
<tr>
<th>Mercury and its compounds</th>
<th>Endrin</th>
<th>Simazine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cadmium and its compounds</td>
<td>Carbon Tetrachloride</td>
<td>Tributyltin compounds</td>
</tr>
<tr>
<td>Gamma-hexachlorocyclohexane</td>
<td>Polychlorinated Biphenyls</td>
<td>Trifluralin</td>
</tr>
<tr>
<td>DDT</td>
<td>Dichlorovos</td>
<td>Fenitrothion</td>
</tr>
<tr>
<td>Pentachlorophenol and its compounds</td>
<td>1,2 Dichloroethane</td>
<td>Azinphos-methyl</td>
</tr>
<tr>
<td>Hexachlorobenzene</td>
<td>Trichlorobenzene</td>
<td>Malathion</td>
</tr>
<tr>
<td>Aldrin</td>
<td>Atrazine</td>
<td>Endosulfan</td>
</tr>
<tr>
<td>Dieldrin</td>
<td></td>
<td>Triphenyltin compounds</td>
</tr>
</tbody>
</table>

HMIP also has significant responsibilities under the EPA in implementing IPC. The Environmental Protection (Prescribed Processes and Substances) Regulations 1991 classifies processes as part A or part B processes according to their potential to pollute the environment. Part A processes are subject to IPC control by HMIP and part B processes are subject to air pollution control by Local Authorities.

**Implementation**

Control under the Water Industry and Water Resources Acts is exercised by the issue of a consent (or in some cases the making of an agreement between a WSC and a trader), by the NRA in the case of controlled waters or by a WSC in the case of a discharge to public sewer. Consents and agreements will contain conditions commensurate with NRA and WSC policies and obligations.
As well as responsibilities in relation to environmental protection, WSCs have a responsibility to serve their industrial customers. To this end each operates a trade effluent treatment and disposal service and in doing so they have clear objectives in mind, these are:

- comply with statute and to protect people and installations
- to provide an attractive and reliable service at a reasonable cost.

Conditions attached to a consent or agreement are designed to reflect these objectives. Applications for consent to discharge special category effluent when referred to the Secretary of State often attract additional conditions set by HMIP. Making and determining a referral can be a time consuming operation and both the trader and the WSC have the opportunity to make representations in respect of the referral. A notice of determination is "given effect" by incorporation into WSC Control documents. The notice will usually set discharge limits on the basis of BTMA and will generally set other conditions. Typically these will include:

- concentration limits for specified substances
- volume and flow rates
- sampling and analysis provisions
- flow measurement requirements
- requirements to keep records of the above and to make information available for inspection by HMIP.

It is essential for WSCs to have a clear view of any new conditions the NRA may apply to the wastewater treatment works consent as a result of authorisation of a sewer discharge and to have in place efficient administrative arrangements to deal with referrals which can involve a considerable amount of time.

**Integrated Pollution Control** further complicates control of discharges to sewer. IPC authorisations are required to consider the Best Practical Environmental Option (BPEO) for disposal of wastes, and operators are required to use Best Available Techniques Not Entailing Excessive Cost (BATNEEC) to prevent or minimise release of prescribed substances to the environment and to render harmless all releases. Unlike authorisations under the Water Act, an IPC authorisation does not give a right of discharge to public sewer and the discharger is still required to obtain the consent of the WSC. Consent conditions may or may not include specific limits for prescribed substances but if they do so the limits are likely to be set according to the requirements of the WSC rather than be necessarily related to the IPC authorisation.

When considering an application for authorisation, HMIP is required to consult the relevant WSC and the NRA as statutory consultees and has a duty to ensure that it does not issue an authorisation which would prejudice any EQS in the receiving watercourse. Close liaison between the three parties is essential during the authorisation process.

**Implementing the Controls** has caused considerable difficulty in practice. Unlike other Member States the UK has opted for a system of control using EQS rather than fixed emission standards for pollutants. In general EQSs, especially for list 1 substances, are extremely low concentrations and in many cases reliable analytical methods have only recently become available. Difficulties still exist in the application of the techniques to trade effluent analysis at the limits of detection required. In addition, there is relatively little reliable information available on the fate of certain of these substances in the wastewater treatment process making the setting of consent limits by WSCs difficult except on the basis of available dilution. This has led a number of WSCs to seek to develop a methodology to determine acceptable concentrations for sewer discharges. A further difficulty arises when deciding acceptable concentrations for substances controlled under the Trade Effluent (Prescribed Processes and Substances) Regulations, HMIP do not have a duty to consider Environmental Quality Standards, instead, limits are set according to BTMA. Limits thus set may
not be stringent enough to satisfy the WSC's requirements in order to comply with their own consents to discharge to controlled waters from wastewater treatment works. It is therefore possible that limits set by WSCs will be lower than those set by HMIP and because any notice of determination is incorporated into the WSC's consent it is possible for two limits for a single substance to appear in the same document. The trader has a right of appeal against any condition set by a WSC but has no such right in the case of conditions set by HMIP. It remains to be seen what the outcome of an appeal to the Director General might be.

Many industrialists have found making an application for IPC authorisation particularly difficult, not least because of the amount of information and degree of detail required to be included with the application. Add to this the fact that different control regimes can apply to some processes at the same time and it is perhaps little wonder that some traders find themselves in a state of confusion.

For example: consider a metal plater operating nickel, cadmium and zinc plating lines. Nickel is not a prescribed substance, neither is nickel plating a prescribed process. Control of the discharge is therefore the responsibility of the WSC.

Zinc plating is not a prescribed process and zinc is not a prescribed substance, it does however contain cadmium as an impurity which will therefore be present in the effluent from the process. HMIP, acting on behalf of the Secretary of State under the Water Industry Act, will wish to control cadmium in the discharge, possibly by the use of "surrogate" control of the zinc concentration.

Cadmium plating is a process prescribed under EPA and therefore requires authorisation by HMIP.

IPC authorisation does not permit discharge to a public sewer and the consent of the WSC is still required before such a discharge can be made. WSCs are statutory consultees in the authorisation process if discharge to public sewer is proposed and will control the discharge to meet their own objectives. Correspondence between consultees and all other relevant documentation (except that considered confidential or commercially sensitive) are entered on a public register and are made available for inspection by interested parties. Similarly, NRA are consultees where a discharge to controlled waters is involved.

Further Developments

In addition to controls on dangerous substances regulatory attention has focused on other parameters in recent years.

Colour, whilst not necessarily harmful, is a visual pollutant and as such is the subject of considerable concern. The NRA are seeking to control discharges of coloured effluent from wastewater treatment plants and this has meant WSCs developing control strategies for discharges to sewer in order to comply with their own consent conditions. North West Water have successfully imposed colour controls, which have been tested in the courts, based on the definition of acceptable thresholds in the receiving water at critical wavelengths and allowing for any "natural" colour in the river. Limits are then applied to each trader discharging coloured effluent on the basis of acceptable optical densities at prescribed wavelengths with the caveat that the limits will not apply if the colour is removed by the treatment afforded at the receiving wastewater treatment works.

Treatability. The requirement to comply with COD as well as BOD limits under the Urban Wastewater Treatment Directive (Table 2) has led WSCs to examine the relationship between BOD and COD, in effluent from wastewater treatment works. In a number of cases, where there is a significant industrial contribution and more particularly where that contribution is from certain industrial sectors, difficulties in meeting the proposed COD requirements are becoming evident even when BOD limits are easily met. WSCs are therefore considering their policies towards industries discharging non-biodegradable COD. Whatever the view taken by individual WSCs there could be an impact for traders discharging to public sewer, either in increased controls or in increased costs associated with COD removal at source or at Wastewater treatment works or both.
Nutrients. The requirement to meet discharge standards for nitrogen and phosphorus from WwTW's in sensitive areas may also bring WSCs to seek to limit those substances in industrial effluent. An alternative would be to install facilities for removal and to recharge the cost preferentially to traders contributing to the problem. This latter approach has not generally found favour with WSCs in the past and there are considerable difficulties of implementation.

**TABLE 2 DIRECTIVE 91/271/EEC**
Requirements for discharges from urban WwTWs (Non-sensitive areas)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biochemical Oxygen Demand (BOD at 20°C)</td>
<td>25 mg/l O₂</td>
</tr>
<tr>
<td>Chemical Oxygen Demand (COD)</td>
<td>125 mg/l O₂</td>
</tr>
<tr>
<td>Total Suspended Solids</td>
<td>35 mg/l</td>
</tr>
</tbody>
</table>

CHARGING SCHEMES

As well as the costs of complying with BTMA, BATNEEC and other regulations, producers of industrial effluent face other costs associated with disposal. Both HMIP and the NRA levy licensing charges according to published schemes whereas WSCs, whilst they do not charge for the granting or holding of a consent, do make charges for reception, conveyance, treatment and disposal of trade effluent. It is best to consider each scheme individually.

NRA. Charges levied by the NRA are designed to recover the cost of granting and monitoring consents and of monitoring the environmental impact from the discharger, rather than from the general taxpayer as would otherwise be the case. Charges are made in two parts, (1) an application charge payable by anyone who applies for a new or revised consent. In 1993/94 this charge is set at £504 (or £72 for minimal discharges). (2) an annual charge payable by anyone who holds a consent.

The annual charge is calculated on the basis of four factors related to:

- Volume (V)
- Contents (C)
- Receiving Water (RW)
- Financial factor (F) (£389 for 1993/4)

For example: A wastewater treatment works discharging between 50,000 m³ and 150,000 m³ per day into estuarial waters with an authorised discharge of complex organic trade waste in the catchment.

The annual charge to the WSC would be:

\[
9.0 (V) \times 15.0 (C) \times 1.5 (RW) \times 389 (F) = £78,772
\]
HMIP. Referrals made by WSCs under the Water Industry Act are not subject to charges. Applications for IPC authorisation are subject to application and annual maintenance charges calculated on a component basis, dependent on the complexity and production capacity of the process and the industrial sector to which it belongs. A fee is also payable if an authorised process is "substantially" altered. 1993/94 charges are shown below.

Application Charge: £3,750/component *
Subsistence Charge: £1,540/component
Substantial Variation fee: £1,250/component

* (£2,500/component for processes regulated under previous legislation)

WSCs make charges for treatment and disposal of trade effluent taking into account volume, COD and Suspended Solids in accordance with a modified "Mogden" formula:

\[
C = R + V + M + B_1 + B_2 \times \frac{O_t}{O_S} + S \times S_t / S_S
\]

where:

- \(C\) = Total charge \((p/m^3)\) of trade effluent
- \(R\) = Reception and conveyance cost \(/m^3\) of sewage
- \(V\) = Volumetric and primary treatment cost \(/m^3\) of sewage
- \(M\) = Cost of providing and operating sea outfalls \(/m^3\) sewage
- \(B_1\) = Capital financing costs of secondary sedimentation \(/m^3\) sewage
- \(B_2\) = Biological oxidation cost \(/m^3\) settled sewage (including cost of secondary sludge disposal)
- \(O_t\) = COD mg/l of trade effluent after one hour quiescent settlement at pH 7.0
- \(O_S\) = COD of average strength settled sewage
- \(S\) = Treatment and disposal cost of primary sludges \(/m^3\) of sewage
- \(S_t\) = Total weight of suspended solids (mg/l) of the trade effluent at pH 7.0
- \(S_S\) = Total weight of suspended solids (mg/l) of average strength crude sewage

![Fig. 1 Comparison of WSC trade effluent charges.](https://iwaponline.com/wst/article-pdf/29/9/1/23717/1.pdf)

It is important to note that the formula takes no account of the presence of complex organic compounds in the effluent. In the light of the charges imposed on the WSC by the NRA and the WSC's own monitoring costs where such substances may be present, it may be that charging schemes will need to be revised.
Similarly, the formula does not take into account treatability or the need to remove nitrogen or phosphorus where similar arguments may apply.

CONCLUSIONS

Regulation of industrial processes and discharges has developed considerably in recent years and continues to do so in the wake of developing legislation and increasing public awareness and environmental expectation. This expectation is not unqualified however, as a recent survey into WCS’s customers willingness to pay for environmental improvements has shown.

As complexity of regulation has increased it has become obvious that dialogue between the regulators and WSCs in implementing the controls is of vital importance. To this end, in the U.K., the Water Service Association has established a liaison committee with HMIP on matters of joint involvement, which has produced a series of guidance notes for use by field inspectors in both organisations.

The UK Government is intent on amalgamating several of its environmental regulators, including HMIP and the NRA into a single environment agency, hopefully this will lead to simplification of the control regime. Meanwhile it is essential that those involved continue to work together in order to resolve the problems so far encountered and to ensure compliance with increasing legislation and regulation.

Environmental improvements can often be costly both in terms of management time and purchase and operation of plant and equipment. It is essential that industrialists count this cost in their budget and pricing structures if they are to comply with the regulations and at the same time remain competitive.

After years of making environmental directives the European Community is intent on forcing Member States to comply. It has been demonstrated that compliance and monitoring compliance is no easy task and there is little room for delay if the hoped for environmental improvements are to be achieved.

ACKNOWLEDGEMENTS

The Author is pleased to acknowledge the assistance given by Glyn Edwards and Gillian Hill of the National Rivers Authority and of Don Litten of Her Majesty's Inspectorate of Pollution in the preparation of this paper.

ABBREVIATIONS

WSC  Water Service Company
EPA  Environmental Protection Act (1990)
IPC  Integrated Pollution Control
HMIP  Her Majesty's Inspectorate of Pollution
NRA  National Rivers Authority
DG  Director General (of Water Services)
COD  Chemical Oxygen Demand
BOD  Biochemical Oxygen Demand
BTMA  Best Technical Means Available
PCB  Poly Chlorinated Biphenzl
BPEO  Best Practical Environmental Option
BATNEEC  Best Available Techniques Not Entailing Excessive Cost
EQS  Environmental Quality Standard.
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