

NRA-WATER QUALITY 87

# DISCHARGES OF WASTE UNDER THE EC TITANIUM DIOXIDE DIRECTIVES



**Report of the  
National Rivers Authority**

**March 1993**



**NRA**

*National Rivers Authority*

**WATER QUALITY SERIES No.10**

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Front cover photograph: Seal colony in the vicinity of Tioxide Greatham Factory outfall.

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# **DISCHARGES OF WASTE UNDER THE EC TITANIUM DIOXIDE DIRECTIVES**

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**REPORT OF THE NATIONAL RIVERS AUTHORITY**



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## CONTENTS

	Page
<b>EXECUTIVE SUMMARY</b>	<b>1</b>
<b>1. INTRODUCTION</b>	<b>3</b>
1.1 The Role of the NRA	3
1.2 The Need for Controls over the Discharges from the Titanium Dioxide Industry	3
<b>2. EC TITANIUM DIOXIDE DIRECTIVES</b>	<b>5</b>
2.1 The Main Directive (78/176/EEC)	5
2.2 The Monitoring Directive (82/883/EEC)	6
2.3 The Amendment Directive (83/29/EEC)	6
2.4 The Harmonisation Directive (89/428/EEC)	6
<b>3. IMPLEMENTATION OF THE TITANIUM DIOXIDE DIRECTIVES IN ENGLAND AND WALES</b>	<b>8</b>
3.1 Discharges	8
3.2 Implementation	8
<b>4. POLLUTION REDUCTION PROGRAMMES</b>	<b>12</b>
4.1 The Initial Phase	12
4.2 Initial Chemical and Biological Surveys	12
4.3 Pollution Reduction Programme	13
4.4 Final Chemical and Biological Surveys	14
<b>5. DETAILS OF MONITORING CARRIED OUT IN 1990 BY THE NRA, FOR DIRECTIVE 82/883/EEC</b>	<b>15</b>
5.1 Water Column Monitoring	15
5.1.1 Humber Estuary Discharges	15
5.1.2 Tees Estuary: Greatham Creek Discharge	16
5.2 Sediment Monitoring	17
5.2.1 Humber Estuary Discharges	17
5.2.2 Tees Estuary: Greatham Creek Discharge	17

5.3	Biological Monitoring	18
5.3.1	Humber Estuary Discharges	18
5.3.2	Tees Estuary: Greatham Creek Discharge	18
5.4	Monitoring in the Vicinity of Landfill Site, Billingham, Cleveland	19
<b>6.</b>	<b>FUTURE DEVELOPMENTS</b>	<b>20</b>
<b>7.</b>	<b>REFERENCES</b>	<b>21</b>
<b>8.</b>	<b>APPENDICES</b>	<b>24</b>
	APPENDIX 1 - Main Directive (78/176/EEC)	24
	APPENDIX 2 - Monitoring Directive (82/883/EEC)	31
	APPENDIX 3 - The Amendment Directive (83/29/EEC)	47
	APPENDIX 4 - Proposals for a Harmonisation Directive and Memorandum	49
<b>9.</b>	<b>PLATES</b>	<b>63</b>
	PLATE 1 - Aerial photographs of the two discharges to the Humber Estuary in 1984	64
	PLATE 2 - Seal Colony in the vicinity of Tioxide Greatham factory outfall	65
	PLATE 3 - Comparison of Iron staining of shoreline of Humber estuary in 1984 and 1989	66
<b>10.</b>	<b>GLOSSARY OF TERMS</b>	<b>67</b>

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## PREFACE

Preventing pollution is seldom a simple matter, and the same may be said of attempts to clean up the environment. Not the least of the many complexities is the framework of national and international legislation, of which the numerous EC Directives form but a part - but a very important part. Nowhere is this more evident than in the Directives relating specifically to the discharge of wastes from the titanium dioxide industries. In order to understand the present position, therefore, it is necessary to examine not only the history of the discharges themselves, but the history of the legislation under which such discharges have been made. This report is therefore very timely, particularly because the utility of EC Directives relating to the environment, and the extent to which they are aimed at specific substances, specific industrial practices, or specific uses of the environment, is an area of some debate. Nevertheless, as the report shows, considerable improvements to the environment have been made via the use of the Directives relating to this particular industry, and the NRA intends to use them to effect even further improvements.

A handwritten signature in black ink, reading 'R. J. Pentreath'. The signature is written in a cursive style with a large, stylized 'P' and 'R'.

R J PENTREATH  
Chief Scientist



## **EXECUTIVE SUMMARY**

### **1. INTRODUCTION**

The NRA has been designated the "competent authority" to ensure that the objectives of the EC Titanium Dioxide Directives are achieved in England and Wales through the exercise of its relevant powers or by direction from the relevant Secretary of State.

Titanium dioxide has increasingly been used as the preferred white pigment by industry, as it is non-toxic and has a high opacity and brilliant whiteness. In the early 1970s a dispute between France and Italy focused attention on the waste produced by the industry, which after much publicity culminated in a series of EC Directives designed to reduce and eventually prevent pollution caused by the production of titanium dioxide pigment.

### **2. EC TITANIUM DIOXIDE DIRECTIVES**

The first Directive (78/176/EEC) was published in 1978 after considerable debate in the European Parliament. It required that any discharge should be authorised, the effects on the receiving water should be monitored and there should be a progressive pollution reduction programme for each discharge. New plants should only be constructed after an environmental impact assessment had been carried out.

The Monitoring Directive (82/883/EEC) published in 1982 required the regulatory bodies to complete a programme of surveillance and monitoring of all environmental media based on the requirements of the 1978 Directive.

The Amendment Directive (83/29/EEC) changed the 1978 Directive to allow the Commission more time to submit proposals for harmonisation programmes for the progressive reduction of pollution.

The Harmonisation Directive (89/428/EEC) called for extra controls on the production processes to further limit the discharge of polluting loads within a defined timescale. The legality of this Directive was brought into question by the Commission and was tested in the European Court of Justice. The ruling of the Court was that the Council had wrongly based the legislation on Article 130S of the Single European Act which required unanimous voting procedures. It should have been based on Article 100A which requires qualified majority voting. The Directive was declared "null and void" and a new proposal under Article 100A was submitted by the Commission in 1991.

### **3. IMPLEMENTATION OF THE TITANIUM DIOXIDE DIRECTIVES IN ENGLAND AND WALES**

At the time of the drafting of the first Directive there were four titanium dioxide production plants in the UK. One has since closed which leaves three current discharges covered by the Directives: Tioxide (Europe) Ltd at Grimsby, SCM Chemicals Ltd at Immingham and Tioxide (Europe) Ltd on Teeside.

The two discharges to the Humber Estuary were controlled by the Anglian Water Authority via work carried out by the Humber Estuary Committee, a joint body consisting of representatives from Yorkshire, Severn Trent and Anglian Water Authorities. The discharges from the two factories were seen to cause localised pollution with visible iron staining on the foreshore.

Under the terms of the EC legislation, the discharger on Teeside was required to carry out a full environmental impact assessment before increased production capacity could be authorised. An undertaking was made to use processes and techniques which were least damaging to the environment and to illustrate compliance with the Directives.

#### **4. POLLUTION REDUCTION PROGRAMMES**

The pollution reduction programme related only to the Humber discharges and was spread over a period of five years, split into three phases.

The first part of the programme was the research and development phase where detailed surveys around the outfalls were used in conjunction with mathematical modelling to derive the size of the mixing zones around the outfalls.

The second phase of the programme was to recalculate the position of the outfalls to ensure that an 80% decrease in the areas of the mixing zones was effected. This phase, and the proposed consent conditions, were subject to a Local Inquiry in Grimsby which was initiated by the Secretary of State for the Environment. The Tioxide discharge was relocated into deeper water 2.2 km from shore and the SCM discharge was relocated a further 300m offshore and fitted with a 50m diffuser.

The final phase of the programme consisted of a major chemical and biological survey of water quality around the new outfalls. The mixing zones were found to have been reduced by at least 97% for those areas affected by the acid discharges. There was also a significant reduction of the iron staining of the foreshore.

#### **5. MONITORING IN 1990**

Samples of water and sediment were taken from the areas affected by the discharges and compared with clean sites remote from the discharges. Results showed that the areas were not affected by the acid releases in the discharge although there was a slight elevation in the iron analyses. The biological monitoring was much more variable and no trend between the affected sites and the clean sites could be detected over the previous three years.

#### **6. FUTURE DEVELOPMENTS**

The proposed new Directive provides for harmonisation of programmes to reduce pollution caused by the production of titanium dioxide as required under Directive 78/176/EEC.

The new proposals incorporate the provisions of the defunct 1989 Directive but set a new timescale.

The manufacture of titanium dioxide is a prescribed process under the Environmental Protection Act 1990, and is timetabled to come under integrated pollution control between 1 November 1993 and 31 January 1994.

**STOP PRESS:** The Directive on procedures for harmonizing the programmes for reduction of pollution from the titanium dioxide industry was adopted in December 1992 and a copy is included as an insert in the cover of this report.

## **1. INTRODUCTION**

### **1.1 The Role of the NRA**

The National Rivers Authority (NRA) was formed in 1989 and has widespread duties and powers relating to water quality, water resources, flood defence, freshwater fisheries and other aspects of inland and coastal waters in England and Wales. Its formation and principal responsibilities arise from the Water Act 1989, which has since been consolidated into the Water Resources Act 1991. Under this Act, the NRA has a duty to consider applications for consents to discharge waste into controlled waters, and a power to consent them if it so decides. These decisions are generally made within the relevant NRA Region on the basis of achievement of environmental standards.

Upon its formation, the NRA inherited a large number of existing discharge consents, and a variety of target environmental objectives and standards. Under what is now the Water Resources Act 1991, there is to be a general introduction of Statutory Water Quality Objectives and their respective Water Quality Standards. There are, however, various objectives and standards which apply to UK waters as a result of EC legislation in the form of Directives. Many of these concern the discharges of certain 'dangerous' substances from industry in general; some, however, are specific to particular industries. In the case of the titanium dioxide industry, a number of EC Directives apply and the UK has a duty to achieve compliance with them. The NRA has been designated to act as the "competent authority" for England and Wales to ensure that the objectives of EC Directives are achieved (in so far as it can through the exercise of the powers available to it) as directed by the relevant Secretary of State. It should be noted, however, that EC Directives are agreements between the Commission and Member States; compliance or otherwise with each Directive is therefore a matter for the two relevant parties.

### **1.2 The Need for Controls over the Discharges from the Titanium Dioxide Industry**

Since the 1930s, titanium dioxide has been increasingly used as a white pigment by industry. Being virtually non-toxic and inert, and of high opacity and brilliant whiteness, it has replaced the earlier toxic white pigments such as white lead and zinc oxide. Its unique properties have resulted in the safe use of titanium dioxide in a wide range of industrial and domestic applications - from the manufacture of paint, plastics, paper and printing inks, to use in the production of cosmetics, toiletries, food and food packaging. It has become an essential component of modern living.

The production of titanium dioxide pigments is carried out on a world-wide basis, and many of the manufacturers operate as multi-national organisations. This allows them to adjust manufacturing capacity in order to take advantage of a variety of national markets.

The two ores that are used to produce titanium dioxide are ilmenite, in which titanium is associated with iron as a black mineral oxide, and rutile, a less common high titanium content ore in which iron may be present as an impurity. The main sources of the ilmenite ores are Australia, Norway, Canada, South Africa and the Indian sub-continent. The purer rutile ore is much scarcer and is becoming exhausted. It is, however, possible to produce a synthetic form of rutile which can reduce the amount of waste products in the subsequent production of pure titanium dioxide pigments. Processes have also been developed to utilise slag - remaining after the extraction of iron from ilmenite - as a source for titanium dioxide.

There are two processes used to produce titanium dioxide. One is the original sulphate process, in which the titanium ore is reacted with sulphuric acid and the resultant titanyl sulphate hydrolysed to form a hydrated oxide. This is then roasted or calcined in a rotary kiln at a temperature of about 1,000°C to produce titanium dioxide pigment either in anatase or rutile crystalline forms. The other is the more recent chloride process, in which ores with a higher titanium content are chlorinated in

the presence of carbon to produce liquid titanium tetrachloride. This is purified by distillation and then oxidised in the vapour phase to give titanium dioxide in the form of the rutile pigment.

The sulphate process has been the more widely used method of producing titanium dioxide. Large quantities of waste products, in the form of sulphuric acid and ferrous sulphate, are produced. This was one of the major factors in siting the UK "sulphate based" factories on large estuaries in order to obtain the maximum dilution of the waste liquid discharges. The closure of one of the Tioxide "sulphate based" factories, situated at Billingham on a tributary of the Tees Estuary, did much to alleviate local pollution. The siting of the new Tioxide factory, using the chloride process, was related to a number of factors including low land costs, and site remoteness which was important for the installation and safety aspects of a bulk chlorine facility. In addition, pollution by the ferrous sulphate waste product was reduced by recovering crystalline ferrous sulphate and using it and its oxidised salt - ferric sulphate - as a water treatment chemical.

In 1972, an international dispute between France and Italy focused attention on the damage to the marine environment caused by the dumping of strong, acidic iron wastes from the manufacture of titanium dioxide pigments. The dispute was caused by the Montedison titanium dioxide manufacturing plant, which is situated at Scarlino on the Tuscany coast, dumping its wastes into the Mediterranean Sea. The resultant iron deposits, which became known as "Red Mud", caused extensive damage to the marine habitat and to the Corsican fishing industry. There were widespread consequences, including the seizure of ships, litigation, and much publicity, that culminated in the formulation of EC legislation. Locally, restrictions were placed on the Montedison factory which eventually closed with the loss of many jobs. The factory was allowed to recommence its manufacturing by stopping the dumping of wastes at sea, modifying the process to use a high grade of ilmenite ore, and partially removing iron and neutralising the waste liquors before discharging through a pipeline to the sea. The plant was subsequently bought by Tioxide (Europe) Ltd and is now operated as part of their world-wide business.

Prior to the preparation of the first Directive on waste from the titanium dioxide industry, the European Commission took the novel step of publishing a 77-page Technical Report, with a 7-page Explanatory Memorandum, on "Pollution caused by the Titanium Dioxide Industry" (EEC 1975). This report, which is of French origin, draws upon the experiences of the Mediterranean "Red Mud" incident and the related ecological surveys. It concluded that "the wastes from the titanium dioxide industry are potentially or actually harmful", and that "the adverse effects on the marine environment are due above all to acidity, the presence of ferrous sulphate, and probably other metals (heavy metals)". The report also stated that "there is no evidence of any toxic effects on man from the consumption of species of fish caught in the discharge areas".

Such environmental considerations were therefore key factors in the siting of the UK factories on the Tees and the Humber Estuaries, ensuring that the possible adverse environmental effects of the waste discharges could be minimised by the massive dilution available. The high alkalinity of the Humber Estuary was also considered to be beneficial in neutralising the acidic wastes.

## 2. EC TITANIUM DIOXIDE DIRECTIVES

### 2.1 The Main Directive (78/176/EEC)

The need for EC legislation was undoubtedly driven by the environmental consequences of dumping wastes from the manufacture of titanium dioxide in the Mediterranean Sea during the early 1970s. The "Directive on waste from the titanium dioxide industry" (78/176/EEC) (Appendix 1) was proposed on the 14 July 1975, debated in the European Parliament in January 1976, and published in the *Official Journal* on the 25 February 1978 (Haigh 1992). Its objective is the progressive reduction and prevention of pollution caused by waste from the titanium dioxide industry with a view to the elimination of all pollution.

The Directive required that any discharge of waste must be authorised; that the effects on the receiving waters must be monitored; and that a pollution reduction programme must be implemented for each discharge. The Directive included a requirement for a toxicity test on the effluent, using the Brine Shrimp (*Artemia salina*). At that time it was a novel approach for the UK. Construction of new manufacturing plants would only be allowed subject to satisfactory environmental impact assessments being carried out and Member States were obliged to submit detailed reports to the Commission to prove that they were complying with the requirements of the Directive.

The 1976 debate in the European Parliament on the Directive highlighted the conflict between the "environmental quality objective" approach favoured by the United Kingdom and the "emission limit" approach favoured by the majority of other Member States. In particular, the UK Government argued that the titanium dioxide manufacturing industry which discharged its wastes under controlled conditions into the North Sea and Atlantic waters with high tidal ranges, should not be subject to the same constraints as those that discharged to the shallow waters and lower tidal excursions of the Mediterranean sea. The debate also emphasised the increased costs to the Italian factory at Scarlino, which arose from the need to use a purer ore and to improve the discharge arrangements of the acidic iron waste. This caused a distortion to commercial competition which led to the call for all Member States to be subject to the legislative constraints. The UK's view was that its titanium dioxide manufacturing industry, producing 40% of the European output and located so that the waste discharges did not cause similar environmental problems, should not be subject to the same constraints as the Italian factory, which only produced 6% of the European output.

The debate also became intertwined with the discussions that had taken place in the formulation of the "Directive on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community" (76/464/EEC), with the UK using the titanium dioxide arguments to support its opposition to the "limit value" approach. In that Directive, generally known by the shortened title "Dangerous Substances in Water", certain substances, selected on the basis of their toxicity, persistence, and their potential for bioaccumulation (List I), can be controlled either by "limit values" set at the Community level (for which "emission standards" set by the Member State must not be exceeded) or by the use of "environmental quality standards" which are set to ensure that appropriate environmental quality objectives (EQO's) are achieved in the receiving waters. Member States choosing the EQO approach are required to satisfy the European Commission on the adequacy of their environmental protection controls by implementing agreed monitoring programmes, and making regular data returns to the Commission. Thus, the EQO approach, which has a more direct environmental basis than the "limit value" approach, is usually much more expensive for the "competent authority" to carry out.

List II substances, are either potential List I substances where no daughter directive has yet been adopted, or substances selected on the grounds that they have "a deleterious effect on the aquatic environment", also are controlled by the use of emission standards that are based on EQOs, with the relevant monitoring programmes. The UK argued that, apart from trace amounts, waste from the

titanium dioxide manufacturing industry did not contain List I substances; therefore all such discharges should be controlled by the EQO approach.

The compromise agreement adopted was that Member States would submit their own programmes for “the progressive reduction of pollution” to the Commission for approval rather than implement the “limit value” approach.

The Directive is an example of the “sectoral approach” to controlling pollution, in that the pollution from a specific industry is targeted.

## **2.2 The Monitoring Directive (82/883/EEC)**

This Directive (Appendix 2) sets out the programme for surveillance and monitoring covering all environmental media such as air, salt water, fresh water, injection into soil and storage and dumping on land. This is based on the requirements of the main Directive (78/176/EEC).

In February 1986, the Department of the Environment (DoE) issued a Circular entitled “Implementation of Directive 82/883/EEC on Procedures for the Surveillance and Monitoring of Environments concerned by waste from the Titanium Dioxide Industry” (DoE 1986). This required Regional Water Authorities (now the NRA in England and Wales), District Councils, and Waste Disposal Authorities in whose areas the environment is affected by waste from the titanium dioxide industry, to implement the monitoring responsibilities of the Directive. Concern was expressed on the additional costs to the regulatory bodies of such monitoring programmes; for example, the Anglian Water Authority, in written evidence to the House of Lords’ Scrutiny Committee in 1981, said that the Directive as proposed would involve them in additional costs of about £50,000 per annum.

## **2.3 The Amendment Directive (83/29/EEC)**

The Amendment Directive (Appendix 3), which was proposed on the 8 July 1982 and published in the *Official Journal* on the 3 February 1983, amended the main Directive (78/176/EEC) to allow the Commission more time to submit suitable proposals to the Council for the harmonisation of the programmes for the progressive reduction of pollution. In fact, the Commission failed to meet the amended deadline.

## **2.4 The Harmonisation Directive (89/428/EEC)**

This Directive dealt with the “procedures for harmonising the programmes for the reduction and eventual elimination of pollution caused by waste from the titanium dioxide industry”. It fulfilled a commitment made in the main Directive, although under certain circumstances Member States were able to delay its implementation. The Directive called for additional controls on the sulphate and chloride processes in order to limit further the discharge of polluting loads, in accordance with a defined timescale.

For the sulphate process, the discharge of solid waste, strong acid waste (pH <5.5), and certain treated metallic wastes would be prohibited from 1993, and the discharge of weak acid waste and neutralised low-level metallic waste would be restricted to 1,200kg (as sulphate) per tonne of titanium dioxide produced from 1993, and to 800kg (as sulphate) per tonne of titanium dioxide produced from 1995.

For the chloride process, the discharge of solid and strong acid wastes would be prohibited from 1993, and the discharge of weak acid waste, treated metallic waste, and neutralised low-level metallic waste would be restricted. Depending on the ore used - natural rutile, synthetic rutile or slag - total chloride discharges would be limited to 130kg, 228kg, or 450kg respectively, per tonne of titanium

dioxide produced from 1993.

The UK Government made an application to the Commission under the terms of the Directive to delay implementation. They did, however, provide the required details of agreed new pollution reduction programmes before the Directive deadline of 31 December 1989. This was in accordance with a requirement in the Directive to provide an action programme should the EQO approach be adopted by the Member State.

Further progress on implementing this Harmonisation Directive has been halted by discussion within the European Community over its legal basis, rather than the actual technical issues involved. Under the original Treaty of Rome, all Community environmental legislation was based on Article 100 and/or Article 235. The former deals with the harmonisation of measures that affect the internal market, and the latter is a residual "catch-all" clause. In either case the resulting Community legislation had to be adopted unanimously by the Council of Ministers. Under the Single European Act of 1986 the original Treaty was amended to allow the formulation of Community legislation for environmental protection in its own right. Article 100a of the Act, which deals with harmonisation measures, permits the legislation to be agreed by qualified majority voting at the Council level, and also increased the European Parliament's powers to influence the proposals being made by the Commission. However, Article 130s of the Act, which deals specifically with environmental protection measures, still requires the unanimous voting procedure.

When the Harmonisation Directive was first proposed in 1983, the Commission formulated the legislation under the provisions of the Treaty of Rome. Following the passing of the Single European Act, the Commission, with the support of the European Parliament, amended the proposed Directive in accordance with the provisions of Article 100a, which requires qualified majority voting. The titanium dioxide case, along with other environmental and harmonisation issues, has produced conflicting views on whether the proposed legislation should be formulated under the terms of Article 100a or Article 130s. The Council decided unanimously that the titanium dioxide harmonisation directive should be in accordance with Article 130s, requiring unanimous voting procedures.

This development was viewed by the Commission, again supported by the European Parliament, as an important matter of principle with wide-ranging consequences for all aspects of Community legislation. On this basis, the Commission appealed in 1989 to the European Court of Justice against the decision of the Council. The arguments before the Court revolved around what was the principal objective of the proposed legislation, with the Commission taking the view that the main aim was to harmonise standards relating to the operation of the free market, while the Council took the view that harmonisation was secondary to the aim of reducing and eventual elimination of pollution caused by the titanium dioxide industry. The Court eventually concluded that the environmental protection and removal of market distortion aims of the Directive were indivisible. Nevertheless, it ruled in favour of the Commission, presumably influenced by the specific wording of the Directive that referred to "the harmonisation of pollution reduction programmes for the industry". The Court also noted that the use of Article 100a obliged the Commission to give a high priority to environmental considerations when preparing new legislation relating to harmonisation measures.

As a consequence of this debate, the Harmonisation Directive has been declared "null and void" by the Court of Justice, and the Commission has issued a Proposal for a Council Directive (Appendix 4) which, apart from the Treaty base and compliance dates, is substantially the same as the annulled Directive (see Future Developments).

### **3. IMPLEMENTATION OF THE TITANIUM DIOXIDE DIRECTIVES IN ENGLAND AND WALES**

#### **3.1 Discharges**

At the time of the first drafting of the main titanium dioxide Directive, there were four production plants in the UK, all of them in England. One of these has since closed. There are currently three discharges covered by the Directive: those of Tioxide (Europe) Ltd at Grimsby and of SCM Chemicals Ltd of Immingham (both on the Humber Estuary) and that of Tioxide (Europe) Ltd on Teeside (Figure 1). Throughout the remainder of this report Tioxide (Europe) Ltd will be referred to as Tioxide and SCM Chemicals Ltd as SCM.

Tables 1, 2 and 3 summarize details of the consents given to the three dischargers.

#### **3.2 Implementation**

Because the UK had opted for the EQO approach, it was necessary to undertake a considerable amount of effort to establish the basis upon which this could be used to implement the Directives.

In the case of the two discharges to the Humber Estuary the area had been well studied by the Anglian, Severn Trent, and Yorkshire Water Authorities through the Humber Estuary Committee, a joint body which consisted of representatives of these three Water Authorities and other organisations. This Committee still exists and includes representatives from the respective NRA Regions.

The Humber Estuary Committee carried out work in the early 1980s to establish nationally acceptable EQOs and standards for the Humber Estuary system. This led to the development of the concept of "mixing zones". The definition of a mixing zone, for the purposes of calculating consent conditions for a discharge, was agreed to be "that area within which the waste discharge is diluted to a concentration that is compatible with the uses/EQO of the surrounding water and where, therefore, some deterioration of water quality and fauna and flora may be accepted". A reduction in the size of the mixing zones would demonstrate improved control of discharges with associated benefits to water quality.

A principal requirement of the main Directive was that discharges must be authorised. One of the major discharges to the Humber (SCM) was exempt from control under the river pollution legislation that was in force at that time. Following discussions between the company, the DoE, and the then Anglian Water Authority, however, a consent for the discharge was issued in 1984. This included special measures to reduce the discharge of mercury, arising from the use of contaminated sulphuric acid feedstock, to acceptable levels.

Although water quality in the Humber Estuary was relatively good, there were exceptions around several industrial discharges, including those of SCM and Tioxide, where there was evidence of localised pollution, due principally to ferrous iron and acid. These discharges damaged the life inhabiting the bed of the estuary and gave rise to an unacceptably large mixing zone at the point of discharge, as the acidic effluents were neutralized by the estuary water.

In 1984, both of these factories discharged through pipes at the low-water mark. There was little or no depth of water to dilute the discharge at low slack water in the tidal cycle. At high slack water the depth of water over the discharge pipes varied between 4m on the neap tides to 7m on the spring tides, which provided better dilution of the discharges.

The Tioxide discharge caused an impoverishment of biological life on extensive intertidal mudflats adjacent to the 800m discharge pipe and produced a heavy iron staining of the sea-wall, with no growth of brown seaweed which would normally be expected.



The bed of the estuary slopes much more steeply in the vicinity of the SCM discharge pipe, which needed to be only 50m long to reach the low-water mark. As with the TiO<sub>2</sub> discharge, there was biological impoverishment of the bed of the estuary, iron staining of the flood bank wall, and a lack of the expected brown seaweed. Aerial photographs of the two discharges to the Humber Estuary in 1984 are shown in Plate 1. The staining of the foreshore by iron salts is very obvious.

For the single discharge to the Tees Estuary, via Greatham Creek, surveys by Northumbrian Water Authority had shown no apparent material effect on its ecology, and no significant depression of pH values.

Under the terms of the EC legislation, TiO<sub>2</sub> were required to carry-out a full environmental impact assessment before receiving authorisation to increase production capacity. This legislation required an undertaking by the company to use those processes and techniques which were least damaging to the environment and which illustrated compliance with all the requirements of the EC titanium dioxide directives, and other relevant national and international legislation (Northumbrian Water Authority 1989). In this case it was therefore not necessary to implement a pollution reduction programme.

The effects of compliance with the Directives at the Teeside site may be a factor in the establishment of a thriving seal colony in the vicinity of the factory outfall (Plate 2). The number of seals appears to be increasing more by immigration than by breeding success. The fact that the seal colony has established itself close to the discharge point is nevertheless encouraging in environmental terms.

TABLE 1: DETAILS OF THE CONSENTS GIVEN TO TIOXIDE (EUROPE) LTD FOR DISCHARGING TO THE SEATON CHANNEL, TEES ESTUARY

	BTP Tioxide Ltd 5/448	Tioxide UK Ltd	
	1/4/87 (29/7/68)	1/5/90	
	Maximum	Daily Average	Maximum
Suspended solids mg/l	1000 (no value)	300	1000
Acid as CaCO <sub>3</sub> mg/l		3000	5000
Iron mg/l		150	450
Chromium mg/l		5	15
Vanadium mg/l		20	60
Mercury mg/l		0.002	0.006
Cadmium mg/l	0.07 (no value)	0.01	0.03

Maximum rate of effluent discharge under first consent was 2,200 gallons per hour.

Maximum rate of effluent discharge under variation of first consent was 1200 m<sup>3</sup> per hour.

Maximum rate of discharge under last variation of consent is 2000 m<sup>3</sup> per hour

Maximum volume of effluent discharged per day dry weather flow is 12000 m<sup>3</sup>.

Please note: the table shows the details of consents following a variation;  
details prior to variation are shown in brackets.

TABLE 2: DETAILS OF CONSENTS GIVEN TO TIOXIDE (EUROPE) LTD TO DISCHARGE TO THE HUMBER ESTUARY

	BTP Tioxide Ltd 1173	Tioxide UK Ltd PR/N/T/S/1433A	
	10/5/77 (revoked 12/9/88)	28/9/90 (7/7/89) relocated deepwater discharge	
	Maximum	Daily Average	Maximum
Temperature °C	35		50 (35)
Suspended solids mg/l	2500	4000	12000
Chemical oxygen demand mg/l		2000	6000
Acid as H <sub>2</sub> SO <sub>4</sub> mg/l	25000	25000	75000
Ferrous iron mg/l	8000		
Permanganate value (4h at 27°C) ppm	1140		
Iron mg/l		10000	20000
Manganese mg/l		300	900
Zinc mg/l		20	60
Copper mg/l		3	9
Lead mg/l		5	15
Dissolved titanium mg/l		700	2000
Chromium mg/l		20	60
Nickel mg/l		2	6
Vanadium mg/l		40	120
Mercury mg/l		0.01	0.03
Cadmium mg/l		0.02	0.02
Arsenic mg/l		0.5 (0.1)	0.5 (0.3)

Maximum volume of effluent per day dry weather flow under consent 1173 was 5.5 million gallons. Maximum volume of effluent per day dry weather flow under consent PR/N/T/S/1433A is 28,500 m<sup>3</sup>.

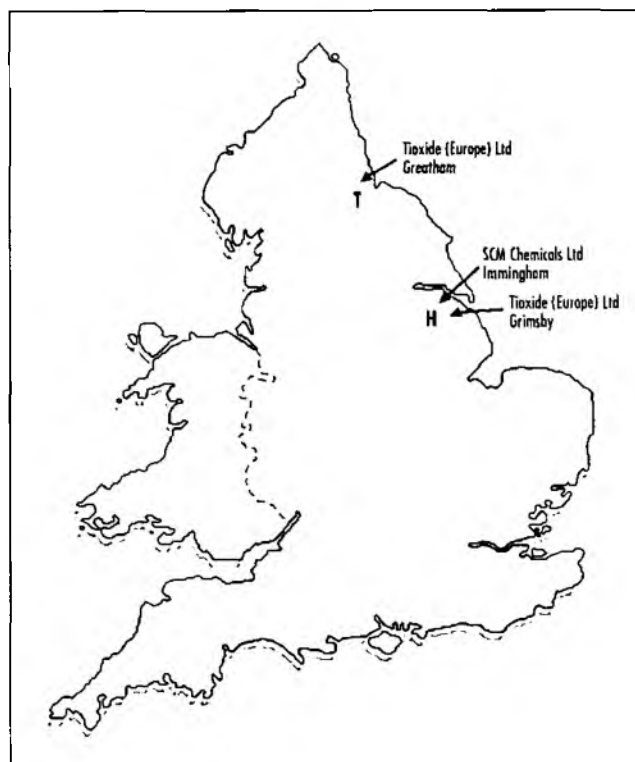
Please note: the table shows the details of consents following a variation; details prior to variation are shown in brackets.

TABLE 3: DETAILS OF CONSENTS GIVEN TO SCM CHEMICALS LTD TO DISCHARGE TO THE HUMBER ESTUARY

	Laporte Industries Ltd PR/3/NF/1303		SCM Ltd PR/3/TS/261A	
	16/7/84 (29/2/84) revoked 12/9/88		8/1/91 (7/7/88) relocated deepwater discharge	
	Daily Average	Maximum	Daily Average	Maximum
Temperature °C		40		40
Suspended solids mg/l	8500	8500	4500	8500
Chemical oxygen demand mg/l	2500	3500	2500	4000
Acid as H <sub>2</sub> SO <sub>4</sub> mg/l	17000	20000	13000	30000
Iron mg/l	5000	7000	5000	10000
Manganese mg/l	100	170	250 (150)	400 (250)
Zinc mg/l	2	3	2	3
Copper mg/l	4	6	3 (2.2)	6
Lead mg/l	1	2 (1)	1	2
Dissolved titanium mg/l	800	1200 (800)	700	1000
Chromium mg/l	25	35	35 (30)	60 (50)
Nickel mg/l	3	5 (3)	3	5
Vanadium mg/l	50	120 (90)	75	120
Mercury mg/l	0.1	0.1	0.01 (0.015)	0.03 (0.045)
Cadmium mg/l	0.02	0.02	0.02	0.02
Arsenic mg/l			0.1	0.2

Maximum volume of effluent per day dry weather flow under consent PR/3/NF/1303 after variation and consent PR/3/TS/261A is 34,000 m<sup>3</sup>.

Please note: the table shows the details of consents following a variation; details prior to variation are shown in brackets.

FIGURE 1 LOCATION OF TITANIUM DIOXIDE MANUFACTURING PLANTS  
ON TEESIDE (T) AND HUMBERSIDE (H)

## 4. POLLUTION REDUCTION PROGRAMMES

### 4.1 The Initial Phase

Article 9 of the Main Directive (78/176/EEC) requires that "Member States shall draw up programmes for the progressive reduction and eventual elimination of pollution caused by waste from existing industrial establishments". In the UK, where pollution control programmes were based on achieving defined EQOs, the requirements of Article 9 were perceived as reducing the polluting effects of the discharges to acceptable levels.

The two companies operating the factories discharging to the Humber Estuary presented a technical case to the DoE that, in the context of the quality of the Estuary as a whole, the environmental impact of their discharges was insignificant.

The scientific and technical evidence was accepted in 1978 by the DoE which forwarded it to the Commission which under the terms of Article 9 of the Directive, "required Member States to send pollution reduction programmes to the Commission, so that it could submit suitable proposals to the Council for the harmonization of these programmes in regard to the reduction and eventual elimination of pollution and the improvement of the conditions of competition in the titanium dioxide industry". The DoE submission, which became known as the "no pollution case", was rejected by the Commission in 1979.

On receipt of the ruling by the Commission, the two companies appealed to the European Court of Justice against the decision, under the terms of the Treaty of Rome. The appeal remains unresolved, and the UK accepted the need to prepare Pollution Reduction Programmes.

The DoE initiated detailed discussions with the two companies discharging to the Humber Estuary, and with the Anglian Water Authority (the regulatory authority at the time) to establish the necessary pollution reduction programme.

This took the form of a three-part programme spread over a period of about 5 years.

### 4.2 Initial Chemical and Biological Surveys

Using Water Research Centre (WRC) mathematical modelling, data were used to derive the size of the mixing zones around the outfalls in terms of the EQS's for soluble iron and acidity (pH 6.0). The sizes of the mixing zones (in hectares) are given in Table 4.

TABLE 4 MIXING ZONE SIZES IN HECTARES

Outfall	pH 6 or less*	1mg/l Fe or more**	Area of moderate to severe biological effect		
			5mg/l Fe or more**	10mg/l Fe or more**	20mg/l Fe or more**
SCM (50m pipe)	27ha	130ha	38ha	9ha	2ha
Tioxide (800m pipe)	160ha	550ha	240ha	97ha	5ha

\* as a 95%ile

\*\* as an annual average

### 4.3 Pollution Reduction Programme

Based on the 1984 surveys, a pollution reduction programme was agreed which called for an 80% decrease in the areas within which a moderate to severe environmental impact could be observed. This was defined in terms of acidity, soluble iron concentrations, and a reduction in the iron staining of the shoreline, and was to be achieved by constructing longer outfalls into the Humber deep-water channels, in order to secure better dilution of the acidic discharges. New consents to discharge were formulated which would ensure that the requisite environmental conditions were achieved.

Due to the heightened environmental concern by local and national groups, in October 1987 the Secretary of State for the Environment set up a public Local Inquiry in Grimsby to examine the Consent Application proposals. The outcome of the Inquiry in August 1988 was that the Anglian Water Authority was required to grant consents relating to longer outfalls. Key conditions of the new consents are given in Tables 2 and 3. There have subsequently been minor amendments to these consents to cater for small volume changes, and to reflect improved analytical procedures.

The construction of the new outfalls was the second part of the pollution reduction programme. The Tioxide discharge was relocated to the main deep water channel; a distance of approximately 2.2km from the shore. At the discharge point this channel is at least 5m deep at low water and can be up to 12m deep at high water on spring tides. No diffuser was fitted because modelling work showed little advantage in having one in such a turbulent mixing area as the deep channel.

The SCM discharge was relocated 300m offshore and fitted with a 50m diffuser. Whilst its new location is short of the main deep water channel, it is in a subsidiary channel of deeper water. The minimum depth of water above the outfall is about 2.5m, rising to over 9m at high water on a spring tide.

Surveys carried out subsequent to the commissioning of the new outfalls showed that the dilution of the acidic effluent discharges was in accordance with predictions from mathematical modelling work carried out by the Water Research Centre (WRC), and that adverse environmental effects were not caused. Water column data interpreted by the WRC mathematical models showed that there had been satisfactory reductions in the size of the mixing zones around the outfalls. Table 5 gives details of calculated mixing zone sizes for 1989, with the calculated 1984 values around the old outfalls for comparison. These should be judged against the surface area of the Humber Estuary, which is in excess of 20,000 hectares.

TABLE 5 MIXING ZONE SIZES IN HECTARES

	SCM		Tioxide	
	Iron	Acid	Iron	Acid
1984	130	27	550	160
1989	92	0.6	44	0

The original consents were revoked as the new consents were issued. SCM appealed to the Secretary of State for the Environment against the revocation of their consent, on the grounds that they might wish to use the old, short outfall in "emergency" situations if the new pipeline became blocked. The Appeal took over two years to determine, by which time the company's concern over blockage of the new pipeline was shown to be groundless. In the event the Secretary of State confirmed the revocation and rejected the appeal.

#### **4.4 Final Chemical and Biological Surveys**

The third stage of the pollution reduction programme was a major chemical and biological water quality survey that was carried out during the summer and early autumn of 1989 around both the new and old outfalls. This was about one year after the commissioning of the new outfalls.

This survey confirmed that the areas of impact around the new outfalls were substantially smaller than those found previously around the old outfalls. This was particularly the case around the new Tioxide outfall, which is in very deep water and where it was difficult to find any significant impact. Around the old SCM outfall there was less evidence of recovery but the new outfall is not far away and may be having some effect. Fish caught in the vicinity of the outfalls showed no evidence of external damage nor were their body burdens of iron and other metals elevated. Details of this major survey were published by the NRA in 1989 (NRA (Anglian) 1989).

The striking environmental improvements in the Humber Estuary resulting from the pollution reduction programme are illustrated by the reduction of iron staining of the shoreline between 1984 and 1989 (Plate 3).

## 5. DETAILS OF MONITORING CARRIED OUT IN 1990 BY THE NRA, FOR DIRECTIVE 82/883/EEC

Under the terms of the Monitoring Directive (82/883/EEC), the NRA is required to carry out water column, sediment and biological monitoring to assess the affect of discharges from plants manufacturing titanium dioxide on the aquatic environment. A brief summary of the monitoring carried out in 1990 is given below.

### 5.1 Water Column Monitoring

#### 5.1.1 Humber Estuary Discharges

After the commissioning of the new, longer SCM and Tioxide outfalls in September 1988, new sample points were designated 500m downstream and in the plume of each discharge. Surveys were carried out on three occasions at the two discharge-related sites and a "control" site not effected by either discharge. Both surface and depth samples were taken. The surface samples (S) were taken at a depth of 0.2m on all three surveys. The depth samples (D) were taken at depth of 4m on the first survey and 5m on the second and third surveys. Several samples were taken at each depth at the discharge related sites during each survey, with one sample taken at each depth at the control site. Table 6 shows the maxima at each site and depth for the determinands salinity, pH, and soluble iron.

TABLE 6

Site	Salinity g/l	pH	Iron (Soluble) mg/l
Control Site (D)	25	7.8	<0.05
Control Site (S)	24	7.8	<0.05
SCM Plume (D)	27	8.0	1.55
SCM Plume (S)	26	8.1	2.89
Tioxide Plume (D)	28	8.2	<0.5
Tioxide Plume (S)	28	8.1	0.189

To demonstrate the water quality outside of the estuary samples were also taken at Sunk Island during the first survey. Maxima at this site are given in Table 7.

TABLE 7

Site	Salinity g/l	pH	Iron (Soluble) mg/l
Sunk Island (D)	25.2	8.0	<0.007
Sunk Island (S)	24	8.0	<0.007

### 5.1.2 Tees Estuary: Greatham Creek Discharge

Water column sampling was carried out at five sites associated with the Tioxide discharge in Greatham Creek and at one control site in the Tees estuary. Three surveys were carried out in 1990, with several samples taken during each survey. As with the samples in the Humber, both surface (S) and depth (D) samples were taken. Table 8 below shows the maxima for the determinands salinity and soluble iron.

TABLE 8

Site	Salinity ‰	Iron (Soluble) mg/l
Seal Sands (S)	33.9	0.014
Seal Sands (D)	33.7	0.008
Laings Basin		
North (S)	33.4	0.120
North (D)	34.0	0.027
Middle (S)	33.4	0.022
Middle (D)	34.0	0.052
South (S)	33.6	1.560
South (D)	34.0	0.203
Power Station Intake		
North (S)	34.0	0.061
North (D)	33.9	0.030
Middle (S)	33.5	0.092
Middle (D)	34.0	0.082
South (S)	33.6	0.008
South (D)	33.8	0.024
Seaton Snook (S)	33.4	0.060
Seaton Snook (D)	34.0	0.021
Phillips Approach (S)	33.5	0.170
Phillips Approach (D)	34.0	0.034
Control Site (S)	33.0	0.050
Control Site (D)	33.8	0.069



## 5.2 Sediment Monitoring

Sediment analysis was carried out on one occasion for both the Humber Estuary and Greatham Creek discharges and are given below. The Humber Estuary discharges were analysed using both <90µm and <63µm fractions, whilst the Greatham Creek results are for the <63µm fraction only.

### 5.2.1 Humber Estuary Discharges

Table 9 shows results as mg/kg dry solids.

TABLE 9

Outfall	SCM		Tioxide	
Fraction	<90µm	<63µm	<90µm	<63µm
No of Samples	1	1	1	1
Copper	41.8	44.1	49.1	49.8
Zinc	171	182	292	287
Cadmium	<0.5	<0.5	<0.5	<0.5
Mercury	0.209	0.174	0.448	0.427
Titanium	2040	2347	5071	5318
Lead	30.9	33.9	111	112
Vanadium	162	192	215	208
Chromium	72.3	97.9	139	133
Iron	49300	51100	43500	42500
Nickel	44.4	48.7	40.0	39.0

### 5.2.2 Tees Estuary: Greatham Creek Discharge

The results were obtained from the <63µm standard fraction size and are given in Table 10 as mg/kg dry weight.

TABLE 10

Sample	Cd	Hg	Cu	Ni	Zn	Cr	Pb	Mn	V	Ti	Fe	Fe loosely bound
Seal Sands	<0.5	0.76	80	32	160	130	87	280	400	3340	11900	5000
Phillips Approach	<0.5	0.84	89	41	180	88	130	690	100	1200	21800	4800
Seaton Snook	0.83	2.5	320	120	600	390	360	1700	71	3440	93900	5100
Laings Basin	0.59	0.73	120	64	240	170	130	650	120	3290	26400	4800
Tees Control	<0.5	1.0	280	67	460	210	220	1300	170	2090	57800	4700
BTP G7A	0.81	0.97	90	41	200	170	99	380	210	2240	14600	4900
G7B	<0.5	0.45	65	34	140	100	58	380	130	3180	10100	5100
G7C	0.60	0.50	51	24	110	93	56	380	170	3430	8790	4500

## 5.3 Biological Monitoring

### 5.3.1 Humber Estuary Discharges

Benthic sampling was carried out in mid July 1990 at selected sample points located 100m upstream of the SCM and Tioxide outfalls, and a control site unconnected with either discharge. A summary of the results can be found in Table 11 below, which includes details of the 1989 and 1988 monitoring for comparison.

TABLE 11

Site	Date	No. of Individuals $N_I$	No. of Species $N_S$
1. Tioxide	July 1990	447	10
	July 1989	453	14
	July 1988	332	21
2. SCM	July 1990	739	8
	July 1989	44682	20
	July 1988	5317	13
3. Control N33	July 1990	2503	20
	July 1989	3062	31
	July 1988	2017	16

$N_I$  = Number of Individuals,  $N_S$  = Number of Species

All values expressed per 0.3m<sup>2</sup>

### 5.3.2 Tees Estuary: Greatham Creek Discharge

Trawl surveys were carried out in April 1990. Although very few fish were caught, there were no anatomical lesions on those taken. The results shown in Table 12 below are from two replicate trawls at the upper and lower sites and three trawls at the control site. Each trawl extended for 800m. Results from replicate trawls are aggregated.

TABLE 12

Site	Organism	No.	Length (mm)
Upper	<i>Crangon crangon</i> (brown shrimp)	169	
	<i>Carcinus maenas</i> (shore crab)	73	
	<i>Pomatoschistus minutus</i> (sand goby)	1	41
	<i>Platichthys flesus</i> (flounder)	1	90
Lower	<i>Carcinus maenas</i> (shore crab)	1	
Control	<i>Crangon crangon</i> (brown shrimp)	1	
	<i>Carcinus maenas</i> (shore crab)	11	
	<i>Asterias rubens</i> (common starfish)	1	

A survey of benthic organisms was also carried out in April 1990. No significant change in species diversity was reported compared with a similar survey in 1989. A summary of results is provided in Table 13 below.

TABLE 13

Site	No. of Individuals $N_i$	No. of Species $N_s$
Control	1056	18
Phillips Approach	215	11
Seaton Snook	31	6
Laing Basin	102	11
BTP O/F	84	9

#### 5.4 Monitoring in the Vicinity of Landfill Site, Billingham, Cleveland

Solid waste from the Tioxide factory at Greatham Creek is sent for disposal to the Cowpen Bewley Landfill at Billingham. The NRA is required to monitor around this landfill under Directive 82/883/EEC. Information for the 'pipe outlet' from the tip area indicates that the quality in 1990 was similar to previous years.

## 6. FUTURE DEVELOPMENTS

Prior to the Harmonisation Directive being declared "null and void", a further pollution reduction programme had been agreed with the two Humberside factories; the Teeside factory already complied with the new EC legislation.

The proposed new Directive provides for the harmonization of programmes for the reduction of pollution caused by waste from the titanium dioxide industry required under Directive 78/176/EEC and for additional controls on the sulphate and chloride processes to limit the discharge of polluting loads within a defined timescale.

The current version of the proposal incorporates a number of amendments along the lines of those requested by the UK. These are:

- a detailed "Explanatory Memorandum" setting out the legal issues associated with the original Harmonisation Directive - if Member States have taken the necessary measures to comply with the annulled Directive, it is not necessary for them to adopt new measures to comply with the new Directive provided that the measures taken already comply with it;
- the addition of a new Article 5 empowering the Commission to grant an extension where Member States have serious technical and economic difficulties in complying with the date in Article 4, provided that a programme for the effective reduction of discharges of waste is submitted - an extension may not exceed five months;
- the addition, in Article 7, of an intermediate target for reductions; and
- the addition of a new date of application: the later of either 31 January 1993, or six months after the adoption of the Directive. Given the current timescale, it is the six months which will now apply, and eventually cancel out the June deadline in Article 5.

The manufacture of titanium dioxide is a prescribed process under the Environmental Protection Act 1990, and is timetabled to come under integrated pollution control between 1 November 1993 and 31 January 1994. Depending on the terms of the Directive, once adopted, it may be necessary to reconsider the means of implementation by possible amendments to the Regulations for the introduction of integrated pollution control under the Environmental Protection Act 1990.

The European Parliament has approved the Common Position of the Council and the Directive is likely to be adopted in the near future. The DoE are in discussion with the NRA and the companies to ensure that the proposals can be implemented as soon as the Directive has been ratified.

**STOP PRESS:** The Directive on procedures for harmonizing the programmes for reduction of pollution from the titanium dioxide industry was adopted in December 1992 and a copy is included as an insert in the cover of this report.

## 7. REFERENCES

DoE 1986. Circular 4/86 Implementation of Directive 82/883/EEC on Procedures for the Surveillance and Monitoring of Environments concerned by waste from the Titanium Dioxide Industry. HMSO.

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Northumbrian Water Authority 1989. The Impact on Greatham Creek of the Proposed New Discharge of Trade Effluent from Tioxide (UK) Ltd.

NRA (Anglian) 1989. Report on the control of Titanium Dioxide Waste to the Humber Estuary. National Rivers Authority.

**APPENDIX 1**  
**Main Directive (78/176/EEC)**

## COUNCIL DIRECTIVE

of 20 February 1978  
on waste from the titanium dioxide industry

(78/176/EEC)

### THE COUNCIL OF THE EUROPEAN COMMUNITIES

Having regard to the Treaty establishing the European Economic Community, and in particular Articles 100 and 235 thereof,

Having regard to the proposal from the Commission,

Having regard to the opinion of the European Parliament<sup>1</sup>,

Having regard to the opinion of the Economic and Social Committee<sup>2</sup>,

Whereas waste from the titanium dioxide industry is liable to be harmful to human health and the environment; whereas it is therefore necessary to prevent and gradually reduce pollution caused by such waste with a view to eliminating it;

Whereas the 1973<sup>3</sup> and 1977<sup>4</sup> European Communities' Programmes of Action on the Environment refer to the need to undertake Community action against waste from the titanium dioxide industry;

Whereas any disparity between the provisions on waste from the titanium dioxide industry already applicable or in preparation in the various Member States may create unequal conditions of competition and thus directly affect the functioning of the common market; whereas it is therefore necessary to approximate laws in this field, as provided for in Article 100 of the Treaty;

Whereas it seems necessary for this approximation of laws to be accompanied by Community action so that one of the aims of the Community in the sphere of protection of the environment and improvement of the quality of life can be achieved by more extensive rules; whereas cer-

tain specific provisions to this effect should therefore be laid down; whereas Article 235 of the Treaty should be invoked as the powers required for this purpose have not been provided for by the Treaty.

Whereas Directive 75/442/EEC<sup>5</sup>, concerns waste disposal in general; whereas for waste from the titanium dioxide industry it is advisable to lay down a special system which will ensure that human health and the environment are protected against the harmful effects caused by the uncontrolled discharge, dumping or tipping of such waste;

Whereas in order to attain these objectives there should be a system of prior authorization as regards the discharge, dumping, storage, tipping or injecting of waste; whereas the issue of this authorization should be made subject to specific conditions;

Whereas discharge, dumping, storage, tipping and injecting of waste must be accompanied both by monitoring of the waste and monitoring and surveillance of the environment concerned;

Whereas for existing industrial establishments Member States must, by 1 July 1980, draw up programmes for the progressive reduction of pollution caused by such waste with a view to its elimination; whereas these programmes must fix the general reduction targets to be attained by 1 July 1987 at the latest and indicate the measures to be taken for each establishment;

Whereas for new industrial establishments Member States must issue a prior authorization; whereas such authorization must be preceded by an environmental impact study and may be granted only to firms which undertake to use only those materials, processes and techniques available on the market that are least damaging to the environment.

<sup>1</sup> OJ No C 28, 9.2.1978, p16

<sup>2</sup> OJ No C 131, 12.6.1976, p18

<sup>3</sup> OJ No C 112, 20.12.1973, p3

<sup>4</sup> OJ No C 139, 13.6.1977, p3

<sup>5</sup> OJ No L 194, 25.7.1975, p39

## HAS ADOPTED THIS DIRECTIVE

### Article 1

1. The aim of this Directive is the prevention and progressive reduction, with a view to its elimination, of pollution caused by waste from the titanium dioxide industry.

2. For the purpose of this Directive:

a. 'pollution' means the discharge by man, directly or indirectly, of any residue from the titanium dioxide manufacturing process into the environment, the results of which are such as to cause hazards to human health, harm to living resources and to ecosystems, damage to amenities or interference with other legitimate uses of the environment concerned;

b. 'waste' means:

- any residue from the titanium dioxide manufacturing process of which the holder disposes or is obliged to dispose under current national legislation;

- any residue from a treatment process of a residue referred to in the first indent;

c. 'disposal' means:

- the collection, sorting, transport and treatment of waste as well as its storage and tipping above ground or underground and its injection into the ground;

- the discharge thereof into surface water, ground water and the sea, and dumping at sea;

- the transformation operations necessary for its re-use, recovery or recycling;

d. 'existing industrial establishments' means those industrial establishments already set up on the date of notification of this Directive;

e. 'new industrial establishments' means those industrial establishments which are in the process of being set up on the date of entry into force of this Directive or which are set up after that date. Extensions to existing industrial establishments leading to an

increase of 15000 tonnes per year or more in the titanium dioxide on-site production capacity of the establishment concerned shall be treated as new industrial establishments.

### Article 2

Member States shall take the necessary measures to ensure that waste is disposed of without endangering human health and without harming the environment, and in particular:

- without risk to water, air, soil and plants and animals;
- without deleteriously affecting beauty-spots or the countryside.

### Article 3

Member States shall take appropriate measures to encourage the prevention, recycling and processing of waste, the extraction of raw materials and any other process for the re-use of waste.

### Article 4

1. The discharge, dumping storage, tipping and injection of waste are prohibited unless prior authorization is issued by the competent authority of the Member State in whose territory the waste is produced. Prior authorization must also be issued by the competent authority of the Member State

- in whose territory the waste is discharged, stored, tipped or injected;

- from whose territory it is discharged or dumped.

2. Authorization may be granted for a limited period only. It may be renewed.

### Article 5

In the case of discharge or dumping, the competent authority may, in accordance with Article 2 and on the basis of the information supplied in accordance with Annex I, grant the



authorization referred to in Article 4 provided that:

- a. the waste cannot be disposed of by more appropriate means;
- b. an assessment carried out in the light of available scientific and technical knowledge shows that there will be no deleterious effect, either immediate or delayed, on the aquatic environment;
- c. there is no deleterious effect on boating, fishing, leisure activities, the extraction of raw materials, desalination, fish and shellfish breeding, on regions of special scientific importance or on other legitimate uses of the waters in question.

#### **Article 6**

In the case of storage, tipping or injection, the competent authority may, in accordance with Article 2, and on the basis of the information supplied in accordance with Annex I, grant the authorization referred to in Article 4, provided that:

- a. the waste cannot be disposed of by more appropriate means;
- b. an assessment carried out in the light of available scientific and technical knowledge shows that there will be no detrimental effect, either immediate or delayed, on underground waters, the soil or the atmosphere;
- c. there is no deleterious effect on leisure activities, the extraction of raw materials, plants, animals, on regions of special scientific interest or on other legitimate uses of the environment in question.

#### **Article 7**

1. Irrespective of the method and extent of treatment of the waste in question, its discharge, dumping, storage, tipping and injection shall be accompanied by the monitoring referred to in Annex II of the waste and of the environment concerned having regard to its physical, chemical, biological and ecological aspects.

2. The monitoring operations shall be carried out periodically by one or more bodies appointed by the Member State the competent authority of which has issued the authorization provided for in Article 4. In the case of cross-frontier pollution between Member States, the body in question shall be appointed jointly by the parties concerned.

3. Within one year of notification of this Directive, the Commission shall submit to the Council a proposal on the procedures for the surveillance and monitoring of the environments concerned. The Council shall act on this proposal within six months of the publication of the opinion of the European Parliament and that of the Economic and Social Committee in the *Official Journal of the European Communities*.

#### **Article 8**

1. The competent authority in the Member State concerned shall take all appropriate steps to remedy one of the following situations, and, if necessary, shall require the suspension of discharge, dumping, storage, tipping or injection operations:

- a. if the results of the monitoring provided for in Annex II (A)(1) show that the conditions for the prior authorization referred to in Articles 4, 5 and 6 have not been fulfilled, or
- b. if the results of the acute toxicity tests referred to in Annex II (A)(2) show that the limits laid down therein have been exceeded, or
- c. if the results of the monitoring provided for in Annex II (B) reveal a deterioration in the environment concerned in the area under consideration, or
- d. if discharge or dumping produces a deleterious effect on boating, fishing, leisure activities, the extraction of raw materials, desalination, fish and shellfish breeding, on regions of special scientific importance or on other legitimate uses of the waters in question, or
- e. if storage, tipping or injection produces a deleterious effect on leisure activities, the extraction of raw materials, plants, animals,

on regions of special scientific importance or on other legitimate uses of the environments in question.

2. If several Member States are concerned, the measures shall be taken after consultation.

#### **Article 9**

1. Member States shall draw up programmes for the progressive reduction and eventual elimination of pollution caused by waste from existing industrial establishments.

2. The programmes mentioned in paragraph 1 shall set general targets for the reduction of pollution from liquid, solid and gaseous waste, to be achieved by 1 July 1987 at the latest. The programmes shall also contain intermediate objectives. They shall, moreover, contain information on the state of the environment concerned, on measures for reducing pollution and on methods for treating waste that is directly caused by the manufacturing processes.

3. The programmes referred to in paragraph 1 shall be sent to the Commission by 1 July 1980 at the latest so that it may, within a period of six months after receipt of all the national programmes, submit suitable proposals to the Council for the harmonization of these programmes in regard to the reduction and eventual elimination of pollution and the improvement of the conditions of competition in the titanium dioxide industry. The Council shall act on these proposals within six months of the publication of the opinion of the European Parliament and that of the Economic and Social Committee in the *Official Journal of the European Communities*.

4. Member States shall introduce a programme by 1 January 1982 at the latest.

#### **Article 10**

1. The programmes referred to in Article 9(1) must cover all existing industrial establishments and must set out the measures to be taken in respect of each of them.

2. Where, in particular circumstances, a Member State considers that, in the case of an individual establishment, no additional measures are necessary to fulfil the requirements of this Directive, it shall, within six months of notification of this Directive, provide the Commission with the evidence which has led it to that conclusion.

3. After conducting any independent verification of the evidence that may be necessary, the Commission may agree with the Member State that it is not necessary to take additional measures in respect of the individual establishment concerned. The Commission must give its agreement, with reasons, within six months.

4. If the Commission does not agree with the Member State, additional measures in respect of that establishment shall be included in the programme of the Member State concerned.

5. If the Commission does agree, its agreement will be periodically reviewed in the light of the results of the monitoring carried out pursuant to this Directive and in the light of any significant change in the manufacturing processes or in environmental policy objectives.

#### **Article 11**

New industrial establishments shall be subject to applications for prior authorization made to the competent authorities of the Member State on whose territory it is proposed to build the establishments. Such authorizations must be preceded by environmental impact surveys. They may be granted only to firms which give an undertaking to use only such of the materials, processes and techniques available on the market as are least damaging to the environment.

#### **Article 12**

Without prejudice to this Directive, Member States may adopt more stringent regulations.

### Article 13

1. For the purposes of this Directive, Member States shall supply the Commission with all the necessary information relating to:

- the authorizations issued pursuant to Articles 4, 5 and 6,
- the results of the monitoring of the environment concerned carried out pursuant to Article 7,
- the measures taken pursuant to Article 8.

They shall also supply the Commission with general information concerning the materials, processes and techniques notified to them pursuant to Article 11.

2. Information acquired as a result of the application of this Article may be used only for the purposes of this Directive.

3. The Commission and the competent authorities of the Member States, their officials and other servants shall not disclose information acquired by them pursuant to this Directive and of a kind covered by the obligation of professional secrecy.

4. Paragraphs 2 and 3 shall not prevent publication of general information or surveys which do not contain information relating to particular undertakings or associations of undertakings.

### Article 14

Every three years the Member States shall prepare a report on the prevention and progressive reduction of pollution caused by waste from the

titanium dioxide industry and shall forward it to the Commission, which shall communicate it to the other Member States.

The Commission shall report every three years to the Council and the European Parliament on the application of this Directive.

### Article 15

1. Member States shall bring into force the measures needed to comply with this Directive within 12 months of its notification and shall forthwith inform the Commission thereof.

2. Member States shall communicate to the Commission the texts of the national laws which they adopt in the field covered by this Directive.

### Article 16

This Directive is addressed to the Member States.

Done at Brussels, 20 February 1978.

*For the Council*

*The President*

Per HÆKKERUP

**ANNEX 1**  
**PARTICULARS WHICH MUST BE SUPPLIED IN ORDER TO OBTAIN THE PRIOR AUTHORIZATION**  
**REFERRED TO IN ARTICLES 4, 5 AND 6**

- A. Characteristics and composition of the matter:
1. total amount and average compositions of matter dumped (eg per year);
  2. form (eg solid, sludge, liquid, or gaseous);
  3. properties: physical (eg solubility and density), chemical and biochemical (eg oxygen demand) and biological;
  4. toxicity;
  5. persistence: physical, chemical and biological;
  6. accumulation and biotransformation in biological materials or sediments;
  7. susceptibility to physical, chemical and biochemical changes and interaction in the environment concerned with other organic and inorganic materials;
  8. probability of production of taints or other changes reducing marketability of resources (fish, shellfish, etc).
- B. Characteristics of dumping of discharge site and methods of disposal;
1. location (eg coordinates of the dumping or discharge area, depth and distance from the coast), location in relation to other areas (eg amenity areas, spawning, nursery and fishing areas and exploitable resources);
  2. rate of disposal per specific period (eg quantity per day, per week, per month);
  3. methods of packaging and containment, if any;
  4. initial dilution achieved by proposed method of release, particularly the speed of the ship;
  5. dispersal characteristics (eg effects of currents, tides, and wind on horizontal transport and vertical mixing);
  6. water characteristics (eg temperature, pH, salinity, stratification, oxygen indices of pollution - dissolved oxygen (DO), chemical oxygen demand (COD), biochemical oxygen demand (BOD), nitrogen present in organic and inorganic form, including ammonia, suspended matter, other nutrients and productivity);
  7. bottom characteristics (eg topography, geochemical and geological characteristics and biological productivity);
  8. existence and effects of other dumpings of discharges which have been made in the area concerned (eg heavy metal background reading and organic carbon content).
- C. Characteristics of the tipping, storage or injection area and disposal methods:
1. geographical situation;
  2. characteristics of adjacent areas;
  3. methods of packaging and containment, if any;
  4. characteristics of the methods of tipping, storage and injection, including an assessment of precautions taken to avoid the pollution of waters, the soil and the atmosphere.

## ANNEX II

### SURVEILLANCE AND MONITORING OF DISPOSAL

#### A. Monitoring of waste.

Disposal operations shall be accompanied by:

1. checks on the quantity, composition and toxicity of the waste to ensure that the conditions for prior authorization referred to in Articles 4, 5 and 6 are fulfilled;
2. tests for acute toxicity on certain species of molluscs, crustaceans, fish and plankton, preferably species commonly found in the discharge areas. In addition, tests shall be carried out on samples of the brine shrimp species (*Artemia salina*).

Over a period of 36 hours and at an effluent dilution of 1/5000, these tests must not reveal:

- more than 20% mortality for adult forms of the species tested,
- and for larval forms, mortality exceeding that of a control group.

#### B. Surveillance and monitoring of the environment concerned

- I. In the case of discharge into fresh water or into the sea or in the case of dumping, such checks shall relate to the three following items: water column, living matter and sediments. Periodic checks on the state of the area affected by the discharges will make it possible to follow the development of the environments concerned.

Monitoring shall include the determination of:

1. pH;
2. dissolved oxygen;
3. turbidity;
4. hydrated iron oxides and hydroxides in suspension;
5. toxic metals in water, suspended solids, sediments and in accumulation in selected benthic and pelagic organisms;
6. the diversity and the relative and absolute abundance of flora and fauna.

#### II. In the case of storage, tipping or injection the monitoring shall include:

1. tests to ensure that surface waters and ground waters are not contaminated. These tests shall include the measurement of:
  - acidity,
  - iron content (soluble and particular),
  - calcium content,
  - toxic metal content (soluble and particulate) if any;
2. where necessary, tests to determine any adverse effects on the structure of the subsoils;
3. a general assessment of the ecology of the area in the vicinity of the tipping, storage or injection point.

**APPENDIX 2**  
**Monitoring Directive (82/883/EEC)**

## COUNCIL DIRECTIVE

of 3 December 1982

on procedures for the surveillance and monitoring of environments concerned by waste from the titanium dioxide industry

(82/883/EEC)

### THE COUNCIL OF THE EUROPEAN COMMUNITIES,

Having regard to the Treaty establishing the European Economic Community, and in particular Articles 100 and 235 thereof,

Having regard to Council Directive 78/176/EEC of 20 February 1978 on waste from the titanium dioxide industry<sup>1</sup>, and in particular Article 7 (3) thereof,

Having regard to the proposal from the Commission<sup>2</sup>,

Having regard to the opinion of the European Parliament<sup>3</sup>,

Having regard to the opinion of the Economic and Social Committee<sup>4</sup>,

Whereas, irrespective of the method and extent of the treatment of wastes from the titanium dioxide industry, the discharge, dumping, storage on, tipping on or injection into the ground of such wastes must be accompanied by measures for the surveillance and monitoring of the environments concerned from a physical, chemical, biological and ecological point of view;

Whereas, in order to monitor the quality of these environments, samples should be taken with a minimum frequency so that the parameters specified in the Annexes may be measured; whereas the number of these sampling operations could be reduced in the light of the results obtained; whereas, to ensure that the monitoring is effective, samples should also be taken if possible in a zone deemed to be unaffected by the discharges in question;

Whereas, in connection with the analyses carried out by the Member States, common reference methods of measurement should be fixed for

determining the parametric values which define the physical, chemical, biological and ecological characteristics of the environments concerned;

Whereas, for the surveillance and monitoring of the environments affected, Member States may at any time lay down other parameters in addition to those laid down by this Directive;

Whereas it is necessary to define the details of the methods of surveillance and monitoring which Member States communicate to the Commission; whereas the Commission shall, with the prior agreement of the Member States, publish a consolidated report on these details;

Whereas in certain natural circumstances it may prove difficult to carry out the surveillance and monitoring operations, and, accordingly, provision must be made for derogation, in certain cases, from this Directive;

Whereas technical and scientific progress may require the rapid adjustment of certain of the provisions contained in the Annex; whereas to facilitate implementation of the requisite measures a procedure should be laid down to establish close cooperation between the Member States and the Commission through a committee on adaptation to scientific and technical progress,

### HAS ADOPTED THIS DIRECTIVE:

#### Article 1

This Directive lays down, pursuant to Article 7(3) of Directive 78/176/EEC, the procedures for the surveillance and monitoring of the effects on the environment, having regard to its physical, chemical, biological and ecological aspects, of the discharge, dumping, storage on, tipping on

<sup>1</sup> OJ No L, 54, 25.2.1978 p19

<sup>2</sup> OJ No C, 356, 31.12.1980, p32 and OJ No C 187, 22.7.1982, p10

<sup>3</sup> OJ No C 149, 14.6.1982, p101

<sup>4</sup> OJ No C 230, 10.9.1981, p5

or injection into the ground of waste from the titanium dioxide industry.

## **Article 2**

For the purpose of this Directive:

- 'environments affected' means the water, the land surface and underground strata and the air in or into which waste from the titanium dioxide industry is discharged, dumped, stored, tipped or injected,
- 'sampling point' means the point at which samples are taken.

## **Article 3**

1. The parameters applicable for the surveillance and monitoring referred to in Article 1 are specified in the Annexes.
2. Where a parameter appears in the 'mandatory determination' column in the Annexes, sampling and analysis of the samples must be carried out in respect of the environmental components indicated.
3. Where a parameter appears in the 'optional determination' column in the Annexes, the Member States shall, if they consider it necessary, have the sampling and analysis of samples carried out for the environmental components indicated.

## **Article 4**

1. Member States shall carry out surveillance and monitoring of the environments affected and of a neighbouring zone deemed to be unaffected, special account being taken of local environmental factors and the manner of disposal, ie whether intermittent or continuous.
2. Except where otherwise specified in the Annexes, Member States shall determine on a case-by-case basis the exact sites from which samples are to be taken, the distance of these sites from the nearest pollutant disposal point and the depth or height at which the samples must be taken.

The samples must be taken at the same location and depth and under the same conditions in the course of successive sampling operations, for example in the case of tidal waters, at the same time in relation to high tide, tidal coefficient.

3. For the monitoring and inspection of the environments affected, Member States shall determine the frequency of sampling and analysis for each parameter listed in the Annexes.

For parameters where determination is mandatory, the frequency of sampling and analysis must not be less than the minimum frequencies indicated in the Annexes. However, once the behaviour, fate and effects of the waste have, as far as possible, been established, and provided there is no significant deterioration in the quality of the environment, Member States may provide for a frequency of sampling and analysis below these frequencies. Should there subsequently be any significant deterioration in the quality of the environment as a result of the waste or of any change in the disposal operation, the Member State shall revert to sampling and analysis at a frequency not less than that specified in the Annexes. If a Member State considers it necessary or advisable, it may distinguish between different parameters, applying this subparagraph to those parameters where no significant deterioration in the quality of the environment has been recorded.

4. For the monitoring and inspection of an appropriate neighbouring zone deemed to be unaffected, the laying down of the frequency of sampling and analysis shall be assessed by the Member States. When a Member State finds that it is not possible to identify such a neighbouring zone, it shall inform the Commission to that effect.

## **Article 5**

1. The reference methods of measurement for determining the parametric values are specified in the Annexes. Laboratories using other methods must ensure that the results obtained are comparable.
2. The containers used to carry the samples, the agents or methods used to preserve a part sample with a view to analysis of one or more parameters, the transport and storage of samples



and their preparation for analysis must be such that they do not significantly affect the analytical results.

## **Article 6**

For the surveillance and monitoring of the environments affected, Member States may, at any time, lay down other parameters in addition to those laid down by this Directive.

## **Article 7**

1. The report which the Member States are required to forward to the Commission pursuant to Article 14 of Directive 78/176/EEC shall contain details of the surveillance and monitoring operations carried out by the bodies appointed in accordance with Article 7(2) of that Directive. These details shall, in respect of each environment affected, include the following information:

- a description of the sampling point, including its permanent features, which may be coded, and other administrative and geographical information. This information shall be provided only once when the sampling point is designated,
- a description of the sampling methods used,
- the results of the measurements of the parameters whose determination is mandatory and, where Member States consider it useful, also those of parameters whose determination is optional,
- the methods of measurement and analysis used and, where appropriate, their limit of detection, accuracy and precision,
- changes, adopted in accordance with Article 4(3), in the frequency of sampling and analysis.

2. The first set of data to be communicated pursuant to paragraph 1 shall be that gathered during the third year following notification of this Directive.

3. The Commission shall, with the prior agreement of the Member State concerned, publish a summary of the information supplied to it.

4. The Commission shall assess the effectiveness of the procedure for the surveillance and monitoring of the environments affected and shall - no later than six years after notification of this Directive - place before the Council, if appropriate, proposals to improve this procedure and, if necessary, to harmonize the methods of measurement including their limit of detection, accuracy and precision and the sampling methods.

## **Article 8**

Member States may derogate from this Directive in the event of flooding or natural disaster or on account of exceptional weather conditions.

## **Article 9**

The requisite amendments to adapt the contents of the Annexes as regards:

- parameters listed in the 'optional determination' column,
- reference methods of measurement,

to scientific and technical progress shall be adopted in accordance with the procedure laid down in Article 11.

## **Article 10**

1. A committee on adaptation to technical progress (hereinafter referred to as 'the committee'), consisting of representatives of the Member States and chaired by a Commission representative, is hereby set up.

2. The committee shall draw up its rules of procedure.

## Article 11

1. Where the procedure laid down in this Article is to be followed, the matter shall be referred to the committee by its chairman, either on his own initiative or at the request of the representative of a Member State.

2. The Commission representative shall submit to the committee a draft of the measures to be taken. The committee shall give its opinion on the draft within a time limit set by the chairman having regard to the urgency of the matter. Opinions shall be delivered by a majority of 45 votes, the votes of the Member States being weighted as provided in Article 148(2) of the Treaty. The chairman shall not vote.

3. a. Where the measures envisaged are in accordance with the opinion of the committee, the Commission shall adopt them.

b. Where the measures envisaged are not in accordance with the opinion of the committee, or if no opinion is delivered, the Commission shall, without delay, submit to the Council a proposal on the measures to be taken. The Council shall act by a qualified majority.

c. If the Council has not acted within three months of the proposals being submitted to it, the proposed measures shall be adopted by the Commission.

## Article 12

Point (c) of Article 8(1) of Directive 78/176/EEC is hereby replaced by the following:

c. if the results of the monitoring which the Member States are obliged to carry out on the environment concerned reveal a deterioration in the areas under consideration, or.

## Article 13

Where waste elimination requires that, in accordance with Article 4(1) of Directive 78/176/EEC, the competent authorities of more than one Member State should issue prior authorizations, the Member States involved shall consult each other on the content and the implementation of the monitoring programme.

## Article 14

1. The Member States shall bring into force the laws, regulations and administrative provisions necessary to comply with this Directive within two years following its notification. They shall forthwith inform the Commission thereof.

2. Member States shall communicate to the Commission the texts of the main provisions of national law which they adopt in the field governed by this Directive.

## Article 15

This Directive is addressed to the Member States.

Done at Brussels, 3 December 1982.

*For the Council*

*The President*

Ch. CHRISTENSEN

**ANNEX I**  
**METHOD OF WASTE DISPOSAL: DISCHARGE INTO AIR**

Components	Parameters to be determined		Minimum annual sampling and analysis frequency	Comments
	mandatorily	optionally		
Air	Sulphur dioxide (SO <sub>2</sub> ) <sup>1</sup> Chlorine <sup>2</sup>	Dust	Continuously	1. Region with surveillance by an existing air pollution surveillance network with at least one station near the production site giving representative readings for pollution emanating from the site.
			12 <sup>3</sup>	2. Region with no surveillance network.  Measurement of total amounts of gaseous discharges emitted by the production site. Where a site has a number of discharge sources, sequential measurements may be made.  The reference methods of measurement for sulphur dioxide is that given in Annex III to Council Directive 80/779/EEC of 15 July 1980 on air quality limit values and guide values for sulphur dioxide and suspended particulates (OJ No L 229, 30.8.1980, p30)

<sup>1</sup> If the production process used is the sulphate process.

<sup>2</sup> To be used once measuring technology allows continuous measurements to be carried out and where the chlorine process is used.

<sup>3</sup> The figures must be sufficiently representative and significant.

# ANNEX II

## METHOD OF WASTE DISPOSAL: DISCHARGE INTO OR IMMERSION IN SALT WATER (estuarine, coastal, open sea)

Components	Parameters to be determined		Minimum annual sampling and analysis frequency	Reference method of measurement
	mandatorily	optionally		
Water column  Non-filtered sea water <sup>1</sup>	Temperature (°C)		3	Thermometry. Measurement is to be carried out on the spot at the time of sampling.
	Salinity (‰)		3	Conductimetry.
	pH (pH unit)		3	Electrometry. Measurement is to be carried out on the spot at the time of sampling.
	Dissolved O <sub>2</sub> (mg/O <sub>2</sub> dissolved/l)		3	- Winkler method.  - Electrochemical method.
	Turbidity (mg solids/l)  or  suspended matter (mg/l)		3	For turbidity: turbidimetry. For suspended matter: gravimetry.  - Weighing after filtration through 0.45 µm pore size membrane filter and drying at 105°C.  - Weighing after centrifugation (minimum time five minutes, average acceleration 2800 to 3200 g) and drying at 105°C.
	Fe (dissolved and in suspension) (mg/l)		3	After the sample has been appropriately prepared, determination by atomic absorption spectrophotometry or by molecular absorption spectrophotometry.
		Cr, total Cd, total Hg (mg/l)	3	- Atomic absorption spectrophotometry.  - Molecular absorption spectrophotometry.
	Ti (mg/l)	V, Mn, Ni, Zn (mg/l)	3	Atomic absorption spectrophotometry.
		Cu, Pb (mg/l)	3	- Atomic absorption spectrophotometry.  - Polarography.

<sup>1</sup> Member States may choose whether to analyse non-filtered or filtered water for substances under 'Parameters'.

Components	Parameters to be determined		Minimum annual sampling and analysis frequency	Reference method of measurement
	mandatorily	optionally		
Sea water filtered through 0.45 µm pore size membrane filter <sup>1</sup>	Dissolved Fe (mg/l)		3	Determination by atomic absorption spectrophotometry or by molecular absorption spectrophotometry.
		Cr, Cd, Hg (mg/l)	3	- Atomic absorption spectrophotometry.  - Molecular absorption spectrophotometry.
		Ti, V, Mn, Ni, Zn (mg/l)	3	Atomic absorption spectrophotometry.
		Cu, Pb (mg/l)	3	- Atomic absorption spectrophotometry.  - Polarography.
Suspended solids remaining in 0.45 µm pore size membrane filter	Total Fe (mg/l)	Cr, Cd, Hg (mg/l)	3	- Atomic absorption spectrophotometry.  - Molecular absorption spectrophotometry.
		Ti, V, Mn, Ni, Zn (mg/l)	3	Atomic absorption spectrophotometry.
		Cu, Pb (mg/l)	3	- Atomic absorption spectrophotometry.  - Polarography.
	Hydrated oxides and hydroxides of iron (mg Fe/l)		3	Extraction of the sample under appropriate acid conditions; measurement by atomic absorption spectrophotometry or by molecular absorption spectrophotometry.  The same method of acid extraction must be used for all samples coming from the same site.

<sup>1</sup> Member States may choose whether to analyse non-filtered or filtered water for substances under 'Parameters'.

Components	Parameters to be determined		Minimum annual sampling and analysis frequency	Reference method of measurement
	mandatorily	optionally		
Sediments  In the top layer of sediment as near the surface as possible	Total Ti, Fe (mg/kg dry matter)	V, Cr, Mn, Ni, Cu, Zn, Cd, Hg, Pb (mg/kg dry matter)	1	Identical methods to those for measurements in the water column.  After appropriate preparation of the sample (wet or dry mineralization and purification). The quantities of metals must be measured for a specific range of particle sizes
	Hydrated oxides and hydroxides of iron (mg Fe/kg)		1	Identical methods to those for measurements in the water column.
Living organisms  Species representative of the site: benthic fish and invertebrates or other appropriate species <sup>1</sup>	Ti, Cr, Fe, Ni, Zn, Pb (mg/kg wet and dry weight)	V, Mn, Cu, Cd, Hg (mg/kg wet and dry weight)	1	Atomic absorption spectrophotometry after appropriate preparation of the composite sample of ground flesh (wet or dry mineralization and purification).  - For fish, the metals must be measured in muscle or other appropriate tissue; the sample must consist of at least 10 specimens.  - For molluscs and crustaceans, the metals must be measured in the flesh. The sample must consist of at least 50 specimens.
Benthic fauna	Diversity and relative abundance		1	Qualitative and quantitative classification of representative species, indicating the specimen count per species, density, dominance.
Planktonic fauna		Diversity and relative abundance	1	Qualitative and quantitative, classification of representative species, indicating the specimen count per species, density, dominance.
Flora		Diversity and relative abundance	1	Qualitative and quantitative, classification of representative species, indicating the specimen count per species, density, dominance.
Fish in particular	Presence of morbid anatomical lesions in fish		1	Visual inspection of samples of the representative species taken for chemical analysis.

<sup>1</sup> Species representative of the site of discharge in particular in terms of their sensitivity to bioaccumulation, eg *Mytilus edulis*, *crangon crangon*, flounder, plaice, cod, mackerel, red mullet, herring, sole (or other appropriate benthic species).

**ANNEX III****METHOD OF WASTE DISPOSAL: DISCHARGE INTO FRESH SURFACE WATER**

Components	Parameters to be determined		Minimum annual sampling and analysis frequency	Reference method of measurement
	mandatorily	optionally		
Water column <sup>1</sup>	Temperature (°C)		3	Thermometry. Measurement is to be carried out on the spot at the time of sampling.
Non-filtered fresh water	Conductivity at 20°C (µS cm <sup>-1</sup> )		3	Electrometric measurement.
	pH (pH unit)		3	Electrometry. Measurement is to be carried out on the spot at the time of sampling.
	Dissolved O <sub>2</sub> (dissolved mg (O <sub>2</sub> /l))		3	-Winkler method.  - Electrochemical method.
	Turbidity (mg solids/l) or suspended matter (mg/l)		3	For turbidity: turbidimetry.  For suspended matter: gravimetry. - Weighing after filtration through 0.45 µm membrane filter and drying at 105°C.  - Weighing after centrifugation (minimum time five minutes, and average acceleration 2800 to 3200 g) and drying at 105°C.

<sup>1</sup> Samples must be taken at the same time of the year and if possible at a depth of 50 cm below the surface.

Components	Parameters to be determined		Minimum annual sampling and analysis frequency	Reference method of measurement
	mandatorily	optionally		
Non-filtered fresh water <sup>1</sup>	Fe (dissolved and in suspension) (mg/l)		3	After the sample has been appropriately prepared, determination by atomic absorption spectrophotometry or by molecular absorption spectrophotometry.
		Cr, total Cd, total Hg (mg/l)	3	- Atomic absorption spectrophotometry.  - Molecular absorption spectrophotometry.
	Ti (mg/l)	V, Mn, Ni, Zn (mg/l)	3	Atomic absorption spectrophotometry.
		Cu, Pb (mg/l)	3	- Atomic absorption spectrophotometry.  - Polarography.
Fresh water filtered through 0.45 µm pore size membrane filter <sup>1</sup>	dissolved Fe (mg/l)		3	Measurement by atomic absorption spectrophotometry or by molecular absorption spectrophotometry
		Cr, Cd, Hg(mg/l)	3	- Atomic absorption.  - Molecular absorption spectrophotometry.
		Ti, V, Mn, Ni, Sn (mg/l)	3	Atomic absorption spectrophotometry.
		Cu, Pb (mg/l)	3	- Atomic absorption spectrophotometry.  - Polarography.

<sup>1</sup> Member States may choose whether to analyse non-filtered water for substances under 'Parameters'.



Components	Parameters to be determined		Minimum annual sampling and analysis frequency	Reference method of measurement
	mandatorily	optionally		
Suspended solids remaining in 0.45 µm pore size membrane filter	Fe (mg/l)	Cr, Cd, Hg (mg/l)	3	- Atomic absorption spectrophotometry.  - Molecular absorption spectrophotometry.
		Ti, V, Mn, Ni, Zn (mg/l)	3	Atomic absorption spectrophotometry.
		Cu, Pb (mg/l)-	3	- Atomic absorption spectrophotometry.  - Polarography.
	Hydrated oxides and hydroxides of iron (mg Fe/l)		3	Extraction of the sample under appropriate acid conditions, measurement by atomic absorption spectrophotometry, or by molecular absorption spectrophotometry.  The same method of acid extraction must be used for all samples coming from the same site.
Sediments  In the top layer of sediment, as near the surface as possible	Ti, Fe (mg/kg dry matter)	V, Cr, Mn, Ni, Cu, Zn, Cd, Hg, Pb (mg/kg dry matter)	1	Identical methods to those for measurements in the water column.  After appropriate preparation of the sample (wet or dry mineralization and purification). The quantities of metals must be measured for a specific range of particle sizes.
	Hydrated oxides and hydroxides of iron (mg Fe/kg)		1	Identical methods to those for measurements in the water column.
Living organisms  Species representative of the site	Ti, Cr, Fe, Ni, Zn, Pb (mg/kg wet and dry weight)	V, Mn, Cu, Cd, Hg (mg/kg wet and dry weight)	1	Atomic absorption spectrophotometry after appropriate preparation of the composite sample of ground flesh (wet or dry mineralization and purification).  - For fish, the metals must be measured in muscle or other appropriate tissue; the sample must consist of at least 10 specimens.  - For molluscs and crustaceans, the metals must be measured in the flesh. The sample must consist of at least 50 specimens.

Components	Parameters to be determined		Minimum annual sampling and analysis frequency	Reference method of measurement
	mandatorily	optionally		
Benthic fauna	Diversity and relative abundance		1	Qualitative and quantitative classification of representative species, indicating the specimen count per species, density, dominance.
Planktonic fauna		Diversity and relative abundance	1	Qualitative and quantitative classification of representative species, indicating the specimen count per species, density, dominance.
Flora		Diversity and relative abundance	1	Qualitative and quantitative classification of representative species, indicating the specimen count per species, density, dominance.
Fish in particular		Presence of morbid anatomical lesions in fish	1	Visual inspection of samples of the representative species taken for chemical analysis.

**ANNEX IV**  
**METHOD OF WASTE DISPOSAL: STORAGE AND DUMPING ON LAND**

Components	Parameters to be determined		Minimum annual sampling and analysis frequency	Reference method of measurement
	mandatorily	optionally		
1. Unfiltered surface water around the site in the area affected by the storage and at a point outside this area <sup>123</sup>	pH (pH unit)		1	Electrometry. Measurement is to be carried out at the time of sampling.
	SO <sub>4</sub> <sup>4-</sup> (mg/l)		1	- Gravimetry.  - Complexometric titration with EDTA.  - Molecular absorption spectrophotometry.
	Ti <sup>5</sup> (mg/l)	V, Mn, Ni, Zn (mg/l)	1	Atomic absorption spectrophotometry.
2. Unfiltered groundwater around the site including, where necessary, outflow points <sup>12</sup>	Fe <sup>6</sup> (mg/l)	Cr (mg/l)	1	- Atomic absorption spectrophotometry.  - Molecular absorption spectrophotometry.
	Ca (mg/l)		1	- Atomic absorption spectrophotometry.  - Complexometric titration.
		Cu, Pb (mg/l)	1	- Atomic absorption spectrophotometry.  - Polarography.
	Cl <sup>5</sup> (mg/l)		1	Titrimetry (Mohr method).
Environment of the storage and dumping site	Visual inspection of: - topography and site management  - effect on sub-soil  - ecology of the site		1	Methods to be chosen by Member States.

<sup>1</sup> Sampling must be carried out at the same time of year.

<sup>2</sup> When monitoring surface water and groundwater, particular attention is to be paid to any matter carried by running water from the waste storage area.

<sup>3</sup> Sampling must be carried out 50 cm beneath the surface of the water, if possible.

<sup>4</sup> Mandatory determination where storage or dumping contains waste from the sulphate process.

<sup>5</sup> Mandatory determination where storage or dumping contains waste from the chlorine process.

<sup>6</sup> Also includes the measurement of Fe in the filtrate (suspended solids).

Components	Parameters to be determined		Minimum annual sampling and analysis frequency	Reference method of measurement
	mandatorily	optionally		
1. Unfiltered surface water around the site in the zone affected by the injection.	pH (pH unit)		1	Electrometry. Measurement is to be carried out at the time of sampling.
	SO <sub>4</sub> <sup>2-</sup> (mg/l)		1	- Gravimetry.  - Complexometric titration with EDTA.  - Molecular absorption spectrophotometry.
2. Unfiltered ground water around the site including out-flow points.	Ti <sup>2+</sup> (mg/l)	V, Mn, Ni, Zn (mg/l)	1	Atomic absorption spectrophotometry.
	Fe <sup>3+</sup> (mg/l)	Cr (mg/l)	1	- Atomic absorption spectrophotometry.  - Molecular absorption spectrophotometry.
	Ca (mg/l)		1	- Atomic absorption spectrophotometry.  - Complexometric titration.
		Cu, Pb (mg/l)	1	- Atomic absorption spectrophotometry.  - Polarography.
	Cl <sup>-</sup> (mg/l)		1	Titrimetry (Mohr method).
Environment Topography	Ground stability		1	Photographic and topographic survey.
	Permeability Porosity		1	Pumping tests. Well-logging.

## **ANNEX V**

### **METHOD OF WASTE DISPOSAL: INJECTION INTO SOIL**

- <sup>1</sup> Mandatory determination where waste from the sulphate process is injected into soil.
- <sup>2</sup> Mandatory determination where waste from the chlorine process is injected into soil.
- <sup>3</sup> Also includes the measurement of Fe in the filtrate (suspended solids).

**APPENDIX 3**  
**The Amendment Directive (83/29/EEC)**

## **COUNCIL DIRECTIVE**

of 24 January 1983

amending Directive 78/176/EEC on waste from the titanium dioxide industry

(83/29/EEC)

### **THE COUNCIL OF THE EUROPEAN COMMUNITIES,**

Having regard to the Treaty establishing the European Economic Community, and in particular Articles 100 and 235 thereof,

Having regard to the proposal from the Commission,

Having regard to the opinion of the European Parliament <sup>1</sup>,

Having regard to the opinion of the Economic and Social Committee <sup>2</sup>,

Whereas there have been difficulties for the Commission to submit, within the time limit stipulated in Article 9 (3) of Directive 78/176/EEC <sup>3</sup>, suitable proposals for the harmonization of the programmes for the progressive reduction of pollution; whereas it is therefore necessary to extend the time limit concerned,

### **HAS ADOPTED THIS DIRECTIVE:**

#### **Article 1**

In Article 9 (3) of Directive 78/176/EEC, the phrase 'The programmes referred to in paragraph 1 shall be sent to the Commission by 1 July 1980 at the latest so that it may, within a period of six months after receipt of all the national programmes, submit suitable proposals to the Council...' shall be replaced by 'By 1 July 1980 at the latest the programmes referred to in paragraph 1 shall be sent to the Commission, which, before 15 March 1983, shall submit suitable proposals to the Council...'

#### **Article 2**

This Directive is addressed to the Member States.

Done at Brussels, 24 January 1983.

*For the Council*

*The President*

H W LAUTENSCHLAGER

<sup>1</sup> OJ No C 292, 8.11.1982, p101.

<sup>2</sup> OJ No C 326, 13.12.1982, p1.

<sup>3</sup> OJ No L 54, 25.2.1978, p19.

**APPENDIX 4**  
**Proposals for a Harmonisation Directive and Memorandum**



Proposal for a

**COUNCIL DIRECTIVE**

on procedures for harmonizing the programmes for the reduction

and eventual elimination of pollution caused by waste from

the titanium dioxide industry

(presented by the Commission)

## EXPLANATORY MEMORANDUM

### 1. Introduction

On 18 April 1983 the Commission, in conformity with Council Directive 78/176/EEC of 20 February 1978 on waste from the titanium dioxide industry, and in particular Article 9 thereof<sup>1</sup>, presented to the Council a proposal for a Directive based on Articles 100 and 235 of the EEC Treaty designed to harmonize the programmes for the reduction and eventual elimination of pollution caused by waste from the titanium dioxide industry and to improve the conditions of competition in that sector<sup>2</sup>.

The proposal was amended in 1984 pursuant to the second paragraph of Article 149 of the EEC Treaty and was then discussed on several occasions by the Council<sup>3</sup>. Following the entry into force of the Single European Act, the Commission changed the legal basis of its proposal to Article 100a.

Nevertheless, at its meeting of 24 and 25 November 1988, the Council agreed a common position basing the proposed Directive on Article 130s of the EEC Treaty. Although Parliament, when consulted by the Council on this change, was of the opinion that the legal basis proposed by the Commission was appropriate, the Council adopted the Directive in question on the basis of Article 130s.

The Commission, considering that Article 100a was the appropriate legal basis for Directive 89/428/EEC<sup>4</sup>, instituted proceedings for annulment before the Court of Justice on 28 September 1989 pursuant to the first paragraph of Article 173 of the EEC Treaty.

In its judgement delivered on 11 June 1991, the Court found that Article 100a of the EEC Treaty was the legal basis which should have been chosen, and annulled Directive 89/428/EEC on the grounds that it lacked a proper legal basis<sup>5</sup>.

The Court's decision has important legal effects, since the national measures transposing the annulled Directive 89/428/EEC have lost their foundation in Community law.

It is worth noting in this respect that Member States should, pursuant to Article 12 of Directive 89/428/EEC, have brought the necessary provisions into force to comply with this Directive at the latest by 31 December 1989 and, furthermore, that transposal has already been achieved to a large extent in those Member States that have discharged their obligations in this field.

Since, apart from the legal basis and the provisions on derogations from application of the Directive, the other provisions serve the intended objective, which is to eliminate distortions of competition and to protect the environment, the Commission takes the view that no Member State need cancel its national measures transposing the Directive.

Finally, Article 176 of the EEC Treaty requires the institution whose act has been declared void to take the necessary measures to comply with the judgement.

To this end, the Commission hereby sends to the Council and Parliament a new proposal for a Directive based on Article 100a of the EEC Treaty.

In order to fill rapidly the temporary legal void created by the above-mentioned annulment decision the Commission considers it appropriate to include in its new proposal provisions ensuring continuity in the achievement of the objectives of the annulled Directive 89/428/EEC. This does not, of course, apply to the legal basis or to the provisions of the Directive allowing derogations to the implementation timetable, as this would be contrary to the requirements of Article 100a of the EEC Treaty.

<sup>1</sup> OJ No L 54, 25.2.1978, p19

<sup>2</sup> OJ No C 138, 26.5.1983, p5

<sup>3</sup> OJ No C 167, 27.6.1984, p56

<sup>4</sup> OJ No L 201, 14.7.1989, p56

<sup>5</sup> Judgement of 11.6.1991, in Case C-300/89,  
**Commission-European Parliament v Council**  
(not yet published)

Consequently, the Commission calls on the other institutions to take all appropriate measures to expedite the adoption procedure.

## 2. Legal Basis

This proposal for a Directive lays down the procedures for harmonizing the programmes for the reduction and eventual elimination of pollution caused by waste from existing industrial establishments in the titanium dioxide industry, pursuant to Article 9 of Council Directive 78/176/EEC of 20 February 1978 on waste from the titanium dioxide industry.

Although national programmes to reduce pollution in this field have been introduced for environmental protection reasons, they need to be harmonized in order to eliminate distortions of competition resulting from differences between the programmes.

The existence and/or maintenance of different national rules applicable to competing industrial establishments in the titanium dioxide sector results in major economic differences regarding in particular the investments which the industry is required to make, which are reflected in the cost of the finished product.

Differences also result in the level of environmental protection in the individual Member States.

For all these reasons, it is necessary to harmonize the programmes.

Given this objective, and in conformity with the grounds stated by the Court in its above-mentioned annulment decision, this proposal for a Directive contributes to completion of the internal market and therefore falls within the scope of Article 100a.

Consequently, and in implementation of the Court's judgement of 11 June 1991 in Case C-300/89, the legal basis for this proposal for a Directive is Article 100a of the EEC Treaty.

## 3. Content of the Proposal

The proposal retains the technical provisions (prohibition of dumping and discharge, limit values) of the annulled Directive 89/428/EEC with the object of ensuring continuity in the achievement of the environmental protection adopted by the Council in this field in 1989.

The Commission considers this approach to be appropriate in view, firstly, of the lengthy political debate in the Community which preceded adoption of Directive 89/428/EEC now declared void and, secondly, of important financial aspects concerned in technology for treating titanium dioxide waste in order to comply with the objectives and implementation timetable of the annulled Directive 89/428/EEC.

In addition, the current temporary legal void created by the annulment decision is likely to have adverse effects on the environment and on the conditions of competition in the titanium dioxide industry; it must therefore be speedily rectified by the adoption of a new directive restoring the conditions created in 1989.

Since the implementation calendar established by the annulled Directive 89/428/EEC has largely been overtaken, this proposal sets new target dates in the near future.

The proposed timetable is based on the following considerations:

- the main provisions of Directive 89/428/EEC now declared void should have been and in fact were implemented between 31 December 1989 and 30 June 1990 in certain Member States (which should therefore not be placed at a disadvantage compared with the other Member States);
- Community legal certainty in the field must be reestablished as quickly as possible.

The timetables for reducing discharges to the aquatic environment and to the air differ from one another.

## A. Discharges to the aquatic environment

The timetable contained in Articles 3 to 6 of the proposal specifies the following dates:

- **31 January 1993** (31.12.1989 in Directive 89/428/EEC now declared void)

1. Prohibition of the dumping of waste (discharge to the aquatic environment from ships or aircraft of any type) (Article 3).
2. Prohibition of discharges (other than dumping) to the aquatic environment of **solid waste** and **strong acid waste** from existing industrial establishments using the sulphate process or the chloride process (Article 4a-b).
3. Prohibition of discharges (other than dumping) to the aquatic environment of **treatment waste** from existing industrial establishments using the sulphate process (Article 4a).
4. Effective date for the reduction of **weak acid waste**, **treatment waste** and **neutralized waste** from existing industrial establishments using the chloride process to certain values of total chloride per tonne of titanium dioxide produced (Article 5b).
5. Final date for communication to the Commission by Member States of their programme for reducing **weak acid waste** and **neutralised waste** from existing industrial establishments using the sulphate process to certain values of total sulphate per tonne of titanium dioxide produced, where these States encounter major technical and economic difficulties (Article 6).

- **31 December 1993** (31.12.1992 in Directive 89/428/EEC now declared void)

Target date for reducing **weak acid waste** and **neutralized waste** from existing industrial establishments using the sulphate process to certain values of total sulphate per tonne of titanium dioxide produced (Article 5a).

- **31 December 1994** (idem Directive 89/428/EEC now declared void)

Expiry of the derogation from the target date for the reduction of **weak acid waste** and **neutralized waste** to certain values of total sulphate per tonne of titanium dioxide produced (sulphate process only) (Article 6).

## B. Discharges to Air

The timetable results from Article 8 of the proposal:

- **31 January 1993** (31.12.1989 in Directive 89/428/EEC now declared void)

Target date for the reduction to certain values of discharges of dust and chlorine from existing establishments using the chloride process (Article 8b i-ii).

- **31 December 1993** (31.12.1990 in Directive 89/428/EEC now declared void)

Target date for the reduction to certain values of discharges of dust from existing establishments using the sulphate process (Article 8a i).

- **1 January 1995** (idem in Directive 89/428/EEC now declared void)

Target date for the reduction to certain values of discharges of SO<sub>2</sub> arising from digestion and calcination steps in the manufacture of titanium dioxide from existing establishments using the sulphate process (Article 8a ii).

The scope for Member States to postpone application of certain provisions, in particular those relating to discharges to the aquatic environment provided for by Articles 5 and 7(2) of the annulled Directive 89/428/EEC have not been maintained in the proposal, as they no longer have any justification.

These Articles enabled Member States to postpone until 31 December 1992 at the latest the implementation date laid down in Articles 3 and 6(b) of Directive 89/428/EEC and that laid down in Article 4 (for which an additional six months' period of grace could be granted by the Commission), provided that the Member States concerned submitted a corresponding effective

programme of reduction to the Commission by 31 December 1989 at the latest.

As no Member State had availed itself of this scope for derogation within the periods laid down in the former Directive and since 10 and 11 Member States respectively had stated that they did not wish to use this derogation, there is no longer any cause to include such provisions.

By contrast, the derogation provided for in Article 7(1) of Directive 89/428/EEC is maintained in Article 6 of this proposal.

## COMMISSION

Proposal for a Council Directive on procedures for harmonizing the programmes for the reduction and eventual elimination of pollution caused by waste from the titanium dioxide industry

(91/C 317/06)

COM(91) 358 final - SYN 362

(Submitted by the Commission on 7 October 1991)

### THE COUNCIL OF THE EUROPEAN COMMUNITIES,

Having regard to the Treaty establishing the European Economic Community, and in particular Article 100a thereof,

Having regard to the proposal from the Commission,

In cooperation with the European Parliament,

Having regard to the opinion of the Economic and Social Committee,

Whereas Council Directive 89/428/EEC of 21 June 1989 on procedures for harmonizing the programmes for the reduction and eventual elimination of pollution caused by waste from the titanium dioxide industry<sup>1</sup> was annulled by the Court of Justice in its judgement of 11 June 1991 on the grounds that it lacked an appropriate legal basis<sup>2</sup>;

Whereas the legal void caused by the annulment of the Directive may have adverse effects on the environment and on conditions of competition in the titanium dioxide production sector; whereas it is necessary to restore the material situation created by the annulled Directive 89/428/EEC;

Whereas the objective of this Directive is to approximate national rules relating to titanium dioxide production conditions in order to eliminate the existing distortions of competition between producers in the industry and to ensure a high level of environmental protection;

Whereas Council Directive 78/176/EEC of 20

February 1978 on waste from the titanium dioxide industry<sup>3</sup>, as last amended by Directive 83/29/EEC<sup>4</sup>, and in particular Article 9 thereof, requires the Member States to draw up programmes for the progressive reduction and eventual elimination of pollution caused by waste from industrial establishments in existence on 20 February 1978;

Whereas these programmes set general targets for the reduction of pollution caused by liquid, solid and gaseous wastes to be achieved by 1 July 1987, whereas these programmes were to be submitted to the Commission so that it could present suitable proposals to the Council for their harmonization with regard to the reduction and eventual elimination of this pollution and the improvement of the conditions of competition in the titanium dioxide industry;

Whereas, in order to protect the aquatic environment, dumping of waste and discharges of certain wastes, in particular of solid and strong acid wastes, should be prohibited and discharges of other wastes, in particular of weak acid and neutralised wastes, should be progressively reduced;

Whereas existing industrial establishments should employ the appropriate systems for treating the wastes in order to meet the requisite targets by the set dates;

Whereas installation of those systems can give rise to major technico-economic difficulties in the case of weak acid waste and neutralised waste from certain establishments; whereas Member States should therefore be able to defer application of these provisions, on condition that a

<sup>1</sup> OJ No L201, 14.7.1989, p56

<sup>2</sup> Judgement of 11 June 1991, Case C-300/89, *Commission v Council*, not yet published.

<sup>3</sup> OJ No L54, 25.2.1978, p19

<sup>4</sup> OJ No L32, 3.2.1983, p28

programme of effective reduction of pollution is drawn up and submitted to the Commission; whereas where Member States experience such difficulties, the Commission should be able to extend the relevant time limits;

Whereas, in respect of discharges of certain wastes, Member States should be able to make use of quality objectives in such a way that the results are equivalent in all respects to those obtained through limit values; whereas such equivalence should be demonstrated in a programme to be presented to the Commission;

Whereas, without prejudice to the obligations placed on Member States by Council Directive 80/779/EEC of 15 July 1980 on air quality limit values and guide values for sulphur dioxide and suspended particulates<sup>1</sup>, as last amended by Directive 89/427/EEC<sup>2</sup>, and Council Directive 84/360/EEC of 28 June 1984 on combating air pollution from industrial plants<sup>3</sup>, it is expedient to protect the quality of the air by fixing appropriate emission standards in respect of gaseous discharges from the titanium dioxide industry;

Whereas, in order to verify the effective application of the measures, Member States should undertake monitoring in relation to the actual production of each establishment;

Whereas all waste from the titanium dioxide industry should be avoided or re-used where technically and economically feasible and whereas such waste should be re-used or disposed of without endangering human health or the environment,

## **HAS ADOPTED THIS DIRECTIVE:**

### **Article 1**

This Directive lays down, as required by Article 9 (3) of Directive 78/176/EEC, procedures for harmonizing the programmes for the reduction

and eventual elimination of pollution from existing industrial establishments and is intended to improve the conditions of competition in the titanium dioxide industry.

### **Article 2**

1. For the purpose of this Directive:

a. where the sulphate process is used:

- 'solid waste' shall mean:
  - insoluble ore residues not broken down by sulphuric acid during the manufacturing process,
  - copperas, ie crystalline ferrous sulphate ( $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ ),

● 'strong acid waste' shall mean:

the mother liquors arising from the filtration phase following hydrolysis of the titanyl sulphate solution. If these mother liquors are associated with weak acid wastes which overall contain more than 0.5% free sulphuric acid and various heavy metals<sup>4</sup>, the liquors and waste taken together shall be considered strong acid waste,

● 'treatment waste' shall mean:

filtration salts, sludges and liquid waste arising from the treatment (concentration or neutralization) or strong acid waste and containing various heavy metals, but not including neutralized and filtered or decanted waste containing only traces of heavy metals and which before any dilution, has a pH value above 5.5,

● 'weak acid waste' shall mean:

wash waters, cooling waters, condensates and other sludges and liquid wastes, other than those included in the above

<sup>1</sup> OJ No L 229, 30.8.1980, p30

<sup>2</sup> OJ No L 201, 14.7.1989, p53

<sup>3</sup> OJ No L 188, 16.7.1984, p20

<sup>4</sup> Strong acid waste which has been diluted until it contains 0.5% or less free sulphuric acid shall also be covered by this definition.

definitions, containing 0.5% or less free sulphuric acid,

- 'neutralized waste' shall mean:

any liquid which has a pH value over 5.5, contains only traces of heavy metals, and is obtained directly by filtration or decantation from strong or weak acid waste after its treatment to reduce its acidity and its heavy metals' content,

- 'dust' shall mean:

all kinds of dust from production plants and in particular ore and pigment dust;

- 'SO<sub>2</sub>' shall mean:

gaseous sulphur dioxide and trioxide released in the various stages of the manufacturing and internal waste treatment processes, including acid droplets;

(b) where the chloride process is used:

- 'solid waste' shall mean:

insoluble ore residues not broken by the chlorine during the manufacturing process,

metal chlorides and metal hydroxides (filtration substances) arising in solid form from the manufacture of titanium tetrachloride,

coke residues arising from the manufacture of titanium tetrachloride,

- 'strong acid waste' shall mean:

waste containing more than 0.5% free hydrochloric acid and various heavy metals<sup>1</sup>,

- 'treatment waste' shall mean:

filtration salts, sludges and liquid waste arising from the treatment (concentration or neutralization) of strong acid waste and

containing various heavy metals, but not including neutralized and filtered or decanted waste containing only traces of heavy metals and which, before any dilution, has a pH value over 5.5,

- 'weak acid waste' shall mean:

wash waters, cooling waters, condensated and other sludges and liquid wastes, other than those included in the above definitions, containing 0.5% or less free hydrochloric acid,

- 'neutralized waste' shall mean:

any liquid which has a pH value over 5.5, contains only traces of heavy metals, and is obtained directly by filtration or decantation from strong or weak acid waste after its treatment to reduce its acidity and its heavy metals' content,

- 'dust' shall mean:

all kinds of dust from production plants and in particular ore, pigment and coke dust,

- 'chlorine' shall mean:

gaseous chlorine released in the various stages of the manufacturing process;

(c) where the sulphate process or the chlorine process is used:

- 'dumping' shall mean:

any deliberate disposal into inland surface waters, internal coastal waters, territorial waters or the high seas of substances and materials by or from ships or aircraft<sup>2</sup>.

2. The terms defined in Directive 78/176/EEC shall have the same meaning for the purposes of this Directive.

<sup>1</sup> Strong acid waste which has been diluted until it contains 0.5% or less free sulphuric acid shall also be covered by this definition.

<sup>2</sup> 'Ships and aircraft' shall mean waterborne vessels and airborne craft of any type whatsoever. This expression shall include air-cushion craft, floating craft, whether self-propelled or not, and fixed or floating platforms.



### Article 3

The dumping of any solid waste, strong acid waste, treatment waste, weak acid waste, or neutralized waste, as referred to in Article 2 shall be prohibited with effect from 31 January 1993.

### Article 4

Member States shall take the necessary measures to ensure that discharges of waste into inland surface waters, internal coastal waters, territorial waters and the high sea are prohibited:

- a. as regards solid waste, strong acid waste and treatment waste from existing industrial establishments using the sulphate process:
  - by 31 January 1993 in all the above-mentioned waters;
- b. as regards solid waste and strong acid waste from existing industrial establishments using the chloride process:
  - by 31 January 1993 in all the above-mentioned waters.

### Article 5

Member States shall take the necessary measures to ensure that discharges of waste are reduced in accordance with the following provisions:

- a. from existing industrial establishments using the sulphate process:
  - weak acid waste and neutralized waste shall be reduced by 31 December 1993 in all waters to a value of not more than 800 kg of total sulphate per tonne of titanium dioxide produced (ie corresponding to the  $\text{SO}_4$  ions contained in the free sulphuric acid and in the metallic sulphates);
- b. from existing industrial establishments using the chloride process:
  - weak acid waste, treatment waste, and neutralized waste shall be reduced by 31 January 1993 in all waters to the following

values of total chloride per tonne of titanium dioxide produced (ie corresponding to the Cl ions contained in the free hydrochloric acid and in the metallic chlorides):

- 130 kg using neutral rutile,
- 228 kg using synthetic rutile,
- 450 kg using slag.

In the case of an establishment using more than one type of ore, the values shall apply in proportion to the quantity of these ores used.

### Article 6

Except where inland surface waters are concerned, Member States may defer the date of application referred to in point (a) of Article 5 until 31 December 1994 at the latest if serious technico-economic difficulties so require and provided that a programme of effective reduction of discharges of such waste is submitted to the Commission by 31 January 1993. Such a programme shall enable the following limit value per tonne of titanium dioxide to be reached by the date shown:

- weak acid waste and neutralized waste: 800 kg
- 31 December 1994.

Three months at the latest following adoption of this Directive the Commission shall be informed of such cases, which shall be the subject of consultation with the Commission. The Commission shall inform the other Member States.

### Article 7

1. As regards the requirement of Article 5, Member States may choose to make use of quality objectives coupled with appropriate limit values applied in such a way that the effects in terms of protecting the environment and avoiding distortions of competition are equivalent to that of the limit values laid down in this Directive.

<sup>1</sup> Such information shall be provided pursuant to Article 14 of Directive 78/176/EEC or separately should circumstances so require.

2. If a Member State chooses to make use of quality objectives, it shall present to the Commission a programme<sup>1</sup>, demonstrating that the measures achieve an effect, which in terms of protecting the environment and avoiding distortion of competition, is equivalent to that of the limit values by the dates when these limit values are applied in accordance with Article 5.

This programme shall be submitted to the Commission at least six months before the Member State proposes to apply the quality objectives.

This programme shall be assessed by the Commission in accordance with the procedures laid down in Article 10 of Directive 78/176/EEC.

The Commission shall inform the other Member States.

#### Article 8

1. Member States shall take the necessary measures to ensure that discharges into the atmosphere are reduced in accordance with the following provisions:

a. in the case of existing industrial establish-

ments using the sulphate process:

- i. as regards dust, discharges shall be reduced by 31 December 1993 to a value of not more than 50 mg/nm<sup>3,2</sup> from major sources and not more than 150 mg/nm<sup>3,2</sup> from any other source<sup>3</sup>;
- ii. as regards SO<sub>x</sub>, discharges arising from digestion and calcination steps in the manufacture of titanium dioxide shall be reduced by 1 January 1995 to a value of not more than 10 kg of SO<sub>2</sub> equivalent per tonne of titanium dioxide produced;
- iii. Member States shall require means to be installed for preventing the emission of acid droplets;
- iv. plants for the concentration of waste acid shall not discharge more than 500 mg/nm<sup>3</sup> SO<sub>x</sub> calculated as SO<sub>2</sub> equivalent<sup>4</sup>;
- v. plants for the roasting of salts generated by the treatment of waste shall be equipped with the best available technology not entailing excessive costs in order to reduce SO<sub>x</sub> emissions;

<sup>2</sup> Cubic metre at a temperature of 273 K and pressure of 101,3 kPa.

<sup>3</sup> Member States shall inform the Commission of those minor sources not included in their measurement.

<sup>4</sup> For new concentration processes the Commission can agree to a different value if the Member States can demonstrate the non-availability of techniques to achieve this standard.

b. in the case of existing industrial establishments using the chloride process:

- i. as regards dust, discharges shall be reduced by 31 January 1993 to a value of not more than  $50 \text{ mg/nm}^3$ <sup>1</sup> for major sources and not more than  $150 \text{ mg/nm}^3$ <sup>2</sup> from any other source<sup>2</sup>;
- ii. as regards chlorine, discharges shall be reduced by 31 January 1993 to a daily average concentration of not more than  $5 \text{ mg/nm}^3$ <sup>3</sup> and not more than  $40 \text{ mg/nm}^3$  at any time.

2. This Directive shall not prejudice Directive 80/779/EEC.

3. The procedure for monitoring the reference measurements for discharges of  $\text{SO}_x$  into the atmosphere is set out in the Annex.

#### Article 9

Member States shall monitor the values and reductions specified in Article 5, 7 and 8 in relation to the actual production of each establishment.

#### Article 10

Member States shall take the measures necessary to ensure that all waste from the titanium dioxide industry, and in particular waste subject to prohibition on discharge or dumping into water or on discharge into the atmosphere is:

- avoided or re-used where technically and economically feasible,

- re-used or disposed of without endangering human health or harming the environment.

The same shall apply to waste arising from the re-use or treatment of the above-mentioned waste.

#### Article 11

1. Member States shall take the measures necessary to comply with this Directive not later than 31 January 1993. They shall forthwith inform the Commission thereof.

When Member States adopt these provisions, these shall contain a reference to this Directive or shall be accompanied by such reference at the time of their official publication. The procedure for such reference shall be adopted for such reference shall be adopted by Member States.

2. Member states shall communicate to the Commission the provisions of national law which they adopt in the field governed by this Directive.

#### Article 12

This Directive is addressed to the Member States.

<sup>1</sup> Cubic metre at a temperature of 273 K and pressure of 101.3 kPa.

<sup>2</sup> Member States shall inform the Commission of those minor sources not included in their measurement.

<sup>3</sup> It is considered that these values correspond to a maximum of 6 gm per tonne of titanium dioxide produced.

**ANNEX**  
**PROCEDURE FOR MONITORING THE REFERENCE**  
**MEASUREMENTS FOR GASEOUS SO<sub>x</sub> EMISSIONS**

For the purposes of calculating the quantities of SO<sub>2</sub> and SO<sub>3</sub> equivalent, discharged by specific installations, account must be taken of the volume of gas discharged over the duration of the specific operations in question and of the average SO<sub>2</sub>/SO<sub>3</sub> content measured over the same period. The SO<sub>2</sub>/SO<sub>3</sub> flow rate and content must be determined under the same temperature and humidity conditions.





PLATE 1 - Aerial photographs of the two discharges to the Humber Estuary in 1984





PLATE 2 - Seal Colony in the vicinity of Tioxide Greatham factory outfall





PLATE 3 - Comparison of Iron staining of shoreline of Humber Estuary in 1984 and 1989





## 10. GLOSSARY OF TERMS

### **Anatase**

A steel blue or yellow crystalline form of titanium dioxide.

### **Bioaccumulation**

The mechanism whereby organisms concentrate in their tissues heavy metals or other stable compounds present in dilute concentrations in saline or fresh water.

### **Body Burden**

The amount of toxic material present in an organism at any one time.

### **Calcine**

To reduce, oxidize, or desiccate by strong heat.

### **Competent Authority**

An organisation designated by the Government as being responsible for the implementation or operation of an EC Directive.

### **Consent**

The permission granted by the NRA or its predecessors to discharge effluent to a controlled water, subject to conditions.

### **Controlled Water**

All rivers, canals, lakes, groundwaters, estuaries and coastal waters to three nautical miles from the shore.

### **Dangerous Substances**

Substances defined by the European Commission as in need of special control because of their toxicity, bioaccumulation and persistence. The substances are classified as List I or List II according to the EC Dangerous Substances Directive (74/464/EEC).

### **Directive**

A type of legislation issued by the European Community which is binding on Member States in terms of results to be achieved.

### **Emission Standards**

Standards set to control the discharge of a pollutant into the environment from a point source. Emission standards may be set individually for each discharge or uniform standards for a particular class of discharge may be applied more widely across a whole area, country or even the Community.

### **Environmental Impact Analysis (EIA)**

The process of identifying and evaluating the effects on the environment of impact factors arising from a change in use. This may include an environmental assessment, the prediction of changes and an evaluation of the significance of these changes.

### **Environmental Quality Objective (EQO)**

The level of water quality that a body of water should achieve, in order to be suitable for its uses.

### **Ferric**

Iron in its trivalent form.

### **Ferrous**

Iron in its divalent form.

### **Heavy Metals**

A group of metals with high atomic mass, which pose specific environmental problems due to their toxicity, persistence, and tendency to bioaccumulate.

### **Ilmenite**

A black ore of titanium.

### **Inert**

A substance in a form that does not easily react chemically with other substances.

**Limit Values**

Upper limits for emission standards.

**List I Substances**

Dangerous Substances which are particularly hazardous on account of their toxicity, bioaccumulation potential, and persistence, and in need of special controls. Standards are set by the European Commission.

**List II Substances**

Dangerous Substances which are less hazardous than List I and are controlled by standards defined nationally by individual Member States.

**Member States**

Countries which are part of the European Community.

**Mixing Zone**

That area or volume of water in which a waste discharge mixes before it is diluted to a concentration that is compatible with the uses/EQO of the surrounding water.

**Opacity**

The extent to which a medium is unable to transmit light.

**Outfall**

The point of discharge of effluent from a pipe.

**Rutile**

A natural mineral form of titanium dioxide.

**Sectoral Approach**

An approach to pollution control which targets a particular industry or industrial sector. All the pollutants emitted by the industry are considered and appropriate controls set for them.

**Statutory Water Quality Objective**

A Quality Objective given a statutory basis by a notice served by the Secretary of State on the NRA in accordance with procedures in Section 83 of the 1991 Water Resources Act.

**Toxic**

Exhibiting poisonous properties.



# COUNCIL DIRECTIVE 92/112/EEC

of 15 December 1992

on procedures for harmonizing the programmes for the reduction and eventual elimination of pollution caused by waste from the titanium dioxide industry

## THE COUNCIL OF THE EUROPEAN COMMUNITIES,

Having regard to the Treaty establishing the European Economic Community, and in particular Article 100a thereof,

Having regard to the proposal from the Commission<sup>1</sup>,

In cooperation with the European Parliament<sup>2</sup>,

Having regard to the opinion of the Economic and Social Committee<sup>3</sup>,

Whereas Council Directive 89/428/EEC of 21 June 1989 on procedures for harmonizing the programmes for the reduction and eventual elimination of pollution caused by waste from the titanium dioxide industry<sup>4</sup> was annulled by the Court of Justice in its judgement of 11 June 1991 on the grounds that it lacked an appropriate legal basis<sup>5</sup>;

Whereas, if Member States have taken the necessary measures to comply with the said Directive, it is not necessary for them to adopt new measures to meet this Directive, provided the measures already taken comply with the latter;

Whereas the legal void caused by the annulment of the said Directive may have adverse effects on the environment and on conditions of competition in the titanium dioxide production sector; whereas it is necessary to restore the material situation created by the said Directive;

Whereas the objective of this Directive is to approximate national rules relating to titanium dioxide production conditions in order to eliminate the existing distortions of competition between the various producers in the industry and to ensure a high level of environmental protection;

Whereas Council Directive 78/176/EEC of 20 February 1978 on waste from the titanium dioxide industry<sup>6</sup>, and in particular Article 9 thereof, requires the Member States to draw up programmes for the progressive reduction and eventual elimination of pollution caused by waste from industrial establishments in existence on 20 February 1978;

Whereas these programmes set general targets for the reduction of pollution caused by liquid, solid and gaseous wastes to be achieved by 1 July 1987; whereas these programmes were to be submitted to the Commission so that it could present suitable proposals to the Council for their harmonization with regard to the reduction and eventual elimination of this pollution and the improvement of the conditions of competition in the titanium dioxide industry;

Whereas, in order to protect the aquatic environment, dumping of waste and discharges of certain wastes, in particular of solid and strong acid wastes, should be prohibited and discharges of other wastes, in particular of weak acid and neutralized wastes, should be progressively reduced;

Whereas existing industrial establishments should employ the appropriate systems for treating the wastes in order to meet the requisite targets by the set dates;

Whereas installation of those systems can give rise to major technico-economic difficulties in the case of weak acid waste and neutralised waste from certain establishments; whereas Member States should therefore be able to defer application of these provisions, on condition that a programme of effective reduction of pollution is drawn up and submitted to the Commission; whereas where Member States experience such difficulties, the Commission should be able to extend the relevant time limits;

Whereas, in respect of discharges of certain wastes, Member States should be able to make use of quality objectives in such a way that the results are equivalent in all respects to those obtained

<sup>1</sup> OJ No C 317, 7.12.1991, p5

<sup>2</sup> OJ No C 94, 13.4.1992, p158 and  
OJ No C 305, 23.11.1992

<sup>3</sup> OJ No C 98, 21.4.1992, p9

<sup>4</sup> OJ No L 201, 14.7.1989, p56

<sup>5</sup> Judgement of 11 June 1991 Case C-300/89 Commission v Council (not yet published).

<sup>6</sup> OJ No L 54, 25.2.1978, p19; Directive as last amended by Directive 83/29/EEC (OJ No L 32, 3.2.1983, p28)

through limit values; whereas such equivalence should be demonstrated in a programme to be presented to the Commission;

Whereas, without prejudice to the obligations placed on Member States by Council Directive 80/779/EEC of 15 July 1980 on air quality limit values and guide values for sulphur dioxide and suspended particulates<sup>1</sup>, and Council Directive 84/360/EEC of 28 June 1984 on the combating of air pollution from industrial plants<sup>2</sup>, it is expedient to protect the quality of the air by fixing appropriate emission standards in respect of gaseous discharges from the titanium dioxide industry;

Whereas, in order to verify the effective application of the measures, Member States should undertake monitoring in relation to the actual production of each establishment;

Whereas all waste from the titanium dioxide industry should be avoided or reused where technically and economically feasible and whereas such waste should be reused or disposed of without endangering human health or the environment,

## HAS ADOPTED THIS DIRECTIVE:

### Article 1

This Directive lays down, as required by Article 9 (3) of Directive 78/176/EEC, procedures for harmonizing the programmes for the reduction and eventual elimination of pollution from existing industrial establishments and is intended to improve the conditions of competition in the titanium dioxide industry.

### Article 2

1. For the purposes of this Directive:

a. where the sulphate process is used:

- *solid waste* shall mean:

insoluble ore residues not broken down by sulphuric acid during the manufacturing process,

copperas, ie crystalline ferrous sulphate ( $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ ),

- *strong acid waste* shall mean:

the mother liquors arising from the filtration phase following hydrolysis of the titanyl sulphate solution. If these mother liquors are associated with weak acid wastes which overall contain more than 0.5% free sulphuric acid and various heavy metals<sup>3</sup>, the liquors and waste taken together shall be considered strong acid waste,

- *treatment waste* shall mean:

filtration salts, sludges and liquid waste arising from the treatment (concentration or neutralization) or strong acid waste and containing various heavy metals, but not including neutralized and filtered or decanted waste containing only traces of heavy metals and which, before any dilution, has a pH value above 5.5,

- *weak acid waste* shall mean:

wash waters, cooling waters, condensates and other sludges and liquid wastes, other than those included in the above definitions, containing 0.5% or less free sulphuric acid,

- *neutralized waste* shall mean:

any liquid which has a pH value over 5.5, contains only traces of heavy metals, and is obtained directly by filtration or decantation from strong or weak acid waste after its treatment to reduce its acidity and its heavy metal content,

- *dust* shall mean:

all kinds of dust from production plants and in particular ore and pigment dust,

- $\text{SO}_x$  shall mean:

gaseous sulphur dioxide and trioxide released in the various stages of the manufacturing and internal waste treatment processes, including acid droplets;

<sup>1</sup> OJ No L 229, 30.8.1980, p30; Directive as last amended by Directive 89/427/EEC (OJ No L 201, 14.7.1989, p53)

<sup>2</sup> OJ No L 188, 16.7.1989, p20

<sup>3</sup> Strong acid waste which has been diluted until it contains 0.5% or less free sulphuric acid shall also be covered by this definition.

## Article 5

In the case of Member States which have serious technical and economic difficulties in complying with the date of application referred to in Article 4, the Commission may grant an extension, provided that a programme for the effective reduction of discharges of such waste is submitted to the Commission by 15 June 1993. That programme must result in a definitive ban on such discharges by 30 June 1993.

No later than three months after adoption of this Directive, the Commission shall be informed of any such cases and shall be consulted thereon. The Commission shall inform the other Member States.

## Article 6

Member States shall take the necessary measures to ensure that discharges of waste are reduced in accordance with the following provisions:

- a. from existing industrial establishments using the sulphate process:
  - weak acid waste and neutralized waste shall be reduced by 31 December 1993 in all waters to a value of not more than 800 kg of total sulphate per tonne of titanium dioxide produced (ie corresponding to the  $\text{SO}_4$  ions contained in the free sulphuric acid and in the metallic sulphates);
- b. from existing industrial establishments using the chlorine process:
  - weak acid waste, treatment waste and neutralised waste shall be reduced by 15 June 1993 in all waters to the following values of total chloride per tonne of titanium dioxide produced (ie corresponding to the Cl ions contained in the free hydrochloric acid and in the metallic chlorides):
    - 130 kg using neutral rutile,
    - 228 kg using synthetic rutile,
    - 450 kg using slag.

In the case of an establishment using more than one type of ore, the values shall apply in proportion to the quantity of these ores used.

## Article 7

Except where inland surface waters are concerned, Member States may defer the date of application referred to in point (a) of Article 6 until 31 December 1994 at the latest if serious technico-economic difficulties so require and provided that a programme of effective reduction of discharges of such waste is submitted to the Commission by 15 June 1993. Such a programme shall enable the following limit value per tonne of titanium dioxide produced to be reached by the date shown:

- weak acid waste and neutralized waste:  
1,200 kg - 15 June 1993,
- weak acid waste and neutralized waste:  
800 kg - 31 December 1994.

Three months at the latest following adoption of this Directive the Commission shall be informed of such cases, which shall be the subject of consultation with the Commission. The Commission shall inform the other Member States.

## Article 8

1. As regards the requirements of Article 6, Member States may choose to make use of quality objectives coupled with appropriate limit values applied in such a way that the effects in terms of protecting the environment and avoiding distortions of competition are equivalent to that of the limit values laid down in this Directive.

2. If a Member State chooses to make use of quality objectives, it shall present to the Commission a programme<sup>1</sup> demonstrating that the measures achieve an effect which, in terms of protecting the environment and avoiding distortion of competition, is equivalent to that of the limit values by the dates when these limit values are applied in accordance with Article 6.

This programme shall be submitted to the Commission at least six months before the Member State proposes to apply the quality objectives.

This programme shall be assessed by the Commission in accordance with the procedures laid down in Article 10 of Directive 78/176/EEC.

The Commission shall inform the other Member States.

<sup>1</sup> Such information shall be provided under Article 14 of Directive 78/176/EEC or separately should circumstances so require.

## Article 9

1. Member States shall take the necessary measures to ensure that discharges into the atmosphere are reduced in accordance with the following provisions:

a. in the case of existing industrial establishments using the sulphate process:

- i. as regards dust, discharges shall be reduced by 31 December 1993 to a value of not more than 50 mg/nm<sup>3 1</sup> from major sources and not more than 150 mg/nm<sup>3 1</sup> from any other source<sup>2</sup>;
- ii. as regards SO<sub>x</sub>, discharges arising from digestion and calcination steps in the manufacture of titanium dioxide shall be reduced by 1 January 1995 to a value of not more than 10 kg of SO<sub>2</sub> equivalent per tonne of titanium dioxide produced;
- iii. Member States shall require means to be installed for preventing the emission of acid droplets;
- iv. plants for the concentration of waste acid shall not discharge more than 500 mg/nm<sup>3</sup> SO<sub>x</sub> calculated as SO<sub>2</sub> equivalent<sup>3</sup>;
- v. plants for the roasting of salts generated by the treatment of waste shall be equipped with the best available technology not entailing excessive costs in order to reduce SO<sub>x</sub> emissions;

b. in the case of existing industrial establishments using the chlorine process:

- i. as regards dust, discharges shall be reduced by 15 June 1993 to a value of not more than 50 mg/nm<sup>3 4</sup> for major sources and not more than 150 mg/nm<sup>3 4</sup> from any other source<sup>5</sup>;

- ii. as regards chlorine, discharges shall be reduced by 15 June 1993 to a daily average concentration of not more than 5 mg/nm<sup>3 6</sup> and not more than 40 mg/ng<sup>3</sup> at any time.

2. This Directive shall not prejudice Directive 80/779/EEC.

3. The procedure for monitoring the reference measurements for discharges of SO<sub>x</sub> into the atmosphere is set out in the Annex.

## Article 10

Member States shall monitor the values and reductions specified in Articles 6, 8 and 9 in relation to the actual production of each establishment.

## Article 11

Member States shall take the measures necessary to ensure that all waste from the titanium dioxide industry, and in particular waste subject to prohibition on discharge or dumping into water or on discharge into the atmosphere is:

- avoided or reused where technically and economically feasible,
- reused or disposed of without endangering human health or harming the environment.

The same shall apply to waste arising from the reuse or treatment of the abovementioned waste.

<sup>1</sup> Cubic metre at a temperature of 273 K and a pressure of 101.3 kPa

<sup>2</sup> Member States shall inform the Commission of those minor sources not included in their measurements.

<sup>3</sup> For new concentration processes the Commission can agree to a different value if the Member States can demonstrate the non-availability of techniques to achieve this standard.

<sup>4</sup> Cubic metre at a temperature of 273 K and a pressure of 101.3 kPa.

<sup>5</sup> Member States shall inform the Commission of those minor sources not included in their measurements.

<sup>6</sup> It is considered that these values correspond to a maximum of six grammes per tonne of titanium dioxide produced.

b. where the chlorine process is used:

- *solid waste* shall mean:

insoluble ore residues not broken down by the chlorine during the manufacturing process,

metal chlorides and metal hydroxides (filtration substances), arising in solid form from the manufacture of titanium tetrachloride,

coke residues arising from the manufacture of titanium tetrachloride,

- *strong acid waste* shall mean:

waste containing more than 0.5% free hydrochloric acid and various heavy metals<sup>1</sup>;

- *treatment waste* shall mean:

filtration salts, sludges and liquid waste arising from the treatment (concentration or neutralization) of strong acid waste and containing various heavy metals, but not including neutralized and filtered or decanted waste containing only traces of heavy metals and which, before any dilution, has a pH value over 5.5,

- *weak acid waste* shall mean:

wash waters, cooling waters, condensates and other sludges and liquid wastes, other than those included in the above definitions, containing 0.5% or less free hydrochloric acid,

- *neutralized waste* shall mean:

any liquid which has a pH value over 5.5, contains only traces of heavy metals, and is obtained directly by filtration or decantation from strong or weak acid waste after its treatment to reduce its acidity and its heavy metal content,

- *dust* shall mean:

all kinds of dust from production plants and in particular ore, pigment and coke dust,

- *chlorine* shall mean:

gaseous chlorine released in the various stages of the manufacturing process;

c. where the sulphate process or the chlorine process is used

- *dumping* shall mean:

any deliberate disposal into inland surface waters, internal coastal waters, territorial waters or the high seas of substances and materials by or from ships or aircraft<sup>2</sup>

2. The terms defined in Directive 78/176/EEC shall have the same meaning for the purposes of this Directive.

### Article 3

The dumping of any solid waste, strong acid waste, treatment waste, weak acid waste, or neutralized waste, as referred to in Article 2 shall be prohibited with effect from 15 June 1993.

### Article 4

Member States shall take the necessary measures to ensure that discharges of waste into inland surface waters, internal coastal waters, territorial waters and the high sea are prohibited:

a. as regards solid waste, strong acid waste and treatment waste from existing industrial establishments using the sulphate process:

- by 15 June 1993 in all the abovementioned waters;

b. as regards solid waste and strong acid waste from existing industrial establishments using the chlorine process:

- by 15 June 1993 in all the abovementioned waters;

<sup>1</sup> Strong acid waste which has been diluted until it contains 0.5% or less free sulphuric acid shall also be covered by this definition.

<sup>2</sup> 'Ships and aircraft' shall mean waterborne vessels and airborne craft of any type whatsoever. This expression shall include air-cushion craft, floating craft, whether self-propelled or not, and fixed or floating platforms.



## Article 12

1. Member States which have not yet taken the necessary measures to comply with this Directive shall bring them into force not later than 15 June 1993. They shall inform the Commission forthwith of the national provisions adopted to comply with this Directive.

When Member States adopt these provisions, they shall contain a reference to this Directive or shall be accompanied by such reference at the time of their official publication. The procedure for such reference shall be adopted by Member States.

2. Member States shall communicate to the Commission the provisions of national law which they adopt in the field governed by this Directive.

## Article 13

This Directive is addressed to the Member States.

Done at Brussels, 15 December 1992.

*For the Council*

*The President*

M HOWARD

## ANNEX

### Procedure for monitoring the reference measurements for gaseous SO<sub>x</sub> emissions

For the purposes of calculating the quantities of SO<sub>2</sub> and SO<sub>3</sub> and acid droplets expressed as SO<sub>2</sub> equivalent, discharged by specific installations, account must be taken of the volume of gas discharged over the duration of the specific operations in question and of the average SO<sub>2</sub>/SO<sub>3</sub> content measured over the same period. The SO<sub>2</sub>/SO<sub>3</sub> flow rate and content must be determined under the same temperature and humidity conditions.