GOALS, REGULATIONS AND INFORMATION NEEDS FOR WASTEWATER DISCHARGE MANAGEMENT — AN AMERICAN PERSPECTIVE

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INTRODUCTION

The aim of this article is to set out the goals of the several participants in wastewater management, the regulations under which such management takes place, and their current developmental status, and most importantly at a conference of this type, the resultant information needs as perceived by a key player in this process, our paper industry. The perspective sought, therefore, is that of the American paper industry, currently operating 600 paper mills and 360 pulp mills, of which 124 are in the kraft category. The industry is broadly distributed across America, with half the kraft mills in the South and significant numbers in the Northeast, Midwest and the Pacific Coast regions.

One hundred and four mills produce bleached chemical pulp using chlorine-based chemicals, yet varying substantially in the extent of their dependence on elemental chlorine. Annual paper production capacity is 80 million tons, 40% of which is bleached. With annual paper use in excess of 700 lbs per capita, paper clearly plays a substantial role in American society, yet is not recognised as a major economic factor despite its 300 year history as a manufacturing industry.

Operating in 43 states and with 20 companies turning over in excess of $1 billion annually, the wastewater management process is necessarily complex, particularly given the key role of the national Environmental Protection Agency (EPA) and its interaction with the state regulatory agencies. While we have not yet seen the political coalescence of the "green movement", it itself is an active participant in what is now a three-way structure shaping discharge management policies and regulations.

Given that such management at its best is a marriage of the discharger and the regulator, and not necessarily made in heaven, it may come as no surprise that there is no full unanimity regarding the goals, and therefore the content of regulations for discharge management.

GOALS OF DISCHARGE MANAGEMENT

EPA's current high-priority goal in administering the Clean Water Act is to eliminate the discharge of "toxic pollutants in toxic amounts". This in turn calls for acceleration of the process by which the states adopt water quality standards governing toxic pollutants, a category that came into common use as "priority pollutants" over ten years ago. The corollary goal then is to assure compliance with the resultant water quality standards. Given that many toxic pollutants have been identified as possible carcinogens by various toxicological procedures and risk assessments, there is a tendency to drive the judgements regarding "toxic amounts" down as low as possible so that the key phrase in this policy formulation becomes "eliminate".
From an industrial perspective the goals can be restated as aimed at providing assurance that: (1) the regulatory judgements regarding water quality requirements are in fact based on scientifically valid criteria; (2) the discharge limitations are based on environmental significance, i.e. sufficient to protect beneficial uses of waterways - in reality, use of receiving waters for water-based recreation and sport/commercial harvesting of aquatic resources is commonly accepted as a beneficial use, otherwise stated as the "fishable and swimmable" goal; and (3) that discharge limitations selected both for national standards and for meeting site-specific water quality maintenance-related standards are, in fact, attainable by demonstrated technology, or in the latter case, by further development of newer manufacturing or wastewater management processes.

THE REGULATORY SYSTEM AND ITS CURRENT PHASES

The national and regional regulatory system flows from the regularly amended Clean Water Act which provides for a dual approach, i.e. technology-based and water-quality-based standards. These are implemented in most cases by state agencies operating within a strong oversight structure established by EPA for the issuance of discharge permits, and with extensive public participation through the mass communication media and the formal judicial process.

Technology-based Standards

These have been developed over a 15 year period, dealing primarily with allowable BOD and suspended solids discharges for various production categories, expressed first as BPT or Best Practicable Technology, later as BCT or Best Conventional Technology, and in 1982 as BAT, Best Available Technology. For a major kraft production category, such as bleached market pulp, the BPT-defined BOD limitations were specified as 9 and 16 lbs per ton on an annual and 30-day average basis, respectively. The 1982 BAT limitation stemmed from an examination of the need for additional parametric limitations other than BOD, considering a long list of compounds of presumed potential harmful effects on aquatic ecosystems. The judgement reached then added only penta- and tri-chlorophenol to the list, based on their prior use as slime control agents. Numerical standards were adopted and non-continuous use was permitted provided discharge levels were less than 0.004 and 0.025 lbs/ton respectively on any given day. Where non-use could be certified these numerical standards were held to be non-applicable.

Additional technology-forcing features were subsequently added to the permitting process, calling on permit writers to use BPJ or Best Professional Judgement in adding BMP or Best Management Practices to the numerical limitations. This was particularly the case for new capacity additions for which New Source Performance Standards (NSPS) were also applied. The relevant BOD levels for new sources are stated as 6 and 11 lbs/ton on an annual and 30-day average basis respectively.

Currently these Effluent Limitations Guidelines are under formal review. As reported here in 1988 by Hamner, the review was to address the need for limitations on an array of chlorinated organic compounds, although none at that time had been definitively associated with significant adverse ecosystem effects in our surface waters. This program is progressing with a target completion date of 1992. It involves (a) cooperative data-gathering through selective effluent analyses, (b) extensive data submittals from all mills, and (c) examination of field ecosystem impact information where available. Its outcome is as yet uncertain, but will undoubtedly lead to some chlorinated-organics-specific limitations and possibly some of a parametric, i.e. AOX-type, character.

Water-quality-based Limitations

The second leg of the permit writing system draws on EPA’s recommended water quality criteria, with which each state is expected to establish use-related numerical standards. Currently relevant to bleached chemical pulp effluent
management are such 1986 criteria as $1.3 \times 10^{-8}$ and $2.1 \times 10^{-7}$ \(\text{µg}/\text{litre}\) for dioxin for aquatic life itself and for human health, based on fish ingestion. For chlorinated phenols 0.1 \(\text{µg}/\text{litre}\) was proposed on an organoleptic basis for 3-chlorophenol. For chloroform, 0.2 \(\text{µg}/\text{litre}\) was proposed for human health considerations, based on potable water intake and presumed human carcinogenicity, a judgement still in dispute.

Waste load allocation judgements and various assimilative capacity models or field studies are used to arrive at the key BOD load limitation. Attention is given to hydrological specifics, i.e. predictable low flow frequencies and artificially controlled stream flows as well.

A new development in the water quality area is the growing addition of bioassay requirements to permits, including short- and long-term exposure tests using juvenile fish and fish food organisms. Those most commonly considered for fresh waters are minnows and various daphnia and algae. For marine waters this practice is far less advanced, with assay organism selection, rearing conditions, and method reproducibility still in the research stages. The regulatory approach being fostered by EPA calls for conduct of a "toxicity reduction program" if the specified bioassay result is not achieved.

With this biomonitoring approach not yet firmly anchored in the permitting system for judging compliance with basic permit terms, an even newer approach is already being fostered. This calls for an assessment of the level of ecosystem health by examination of aquatic organism community structure. While a legitimate approach, and superior in some respects to bioassay-type monitoring, it suffers from a lack of sufficient information in practice with which to differentiate normal and abnormal conditions, let alone their practical significance. In a paper presented before this group two years ago, we emphasised the need for developing a suitable interpretive framework within which to judge the significance of any observed biological effect for determining whether "fishable and swimmable" criteria are being met or contravened.

Another water-quality-related procedure being used to mandate changes in discharge permits is the observance of changes in aquatic population deemed on a reconnaissance basis by EPA to be adverse. Referred to as the "304 (1)" approach, its most recent manifestation is the use of findings of trace amounts of dioxins in nearby fish to reopen unexpired permits. Coupled with an EPA interim permitting strategy resulting from a recent judicial decision, this has produced considerable controversy and disagreement among EPA, state agencies, and the industry, with strong elements of public participation as well. This is not unexpected considering the extent of disagreement over the safe level of human intake of bleaching-derived trace chemicals, such as 2,3,7,8-dioxin, whose other environmental sources far exceed those from pulp bleaching.

MAJOR INFORMATION NEEDS FOR AN EFFECTIVE AND EQUITABLE EFFLUENT REGULATORY SYSTEM

Given the character of this conference and its program content, this leads to the last section of this article, namely the current information needs for advancing control technology, monitoring permit compliance, and most importantly, selection of supportable permit terms reflecting sound scientific understanding of water quality protection needs. The general categories of such information needs have already been addressed and need not be restated here. Those relatable to the presence of chlorinated organics in general, chlorinated dioxins in particular, as well as other specific chlororganics and generic measures of their presence, deserve some discussion however, and much study.

(1) The attention already directed toward AOX, particularly in the Nordic countries, requires that we examine the relation between AOX-type measurements and the various forms of biological response to effluent presence.
(2) This leads next to an examination of both the human and environmental health impacts of several molecular weight fractions of AOX as well as specific chlororganic compounds of current interest.

(3) This is followed in turn by the need for assembly of information on the environmental fate and transport of such compounds of interest. This should be considered broadly so as to include the important bioaccumulation phenomenon.

(4) Since the source of chlororganics lies in the pulping/bleaching/delignification technology, we must continue to assemble such performance data for already existing optional technologies, and where found necessary, examine new possibilities.

(5) Similarly, the chlororganic compound removal capability of existing wastewater management systems must be better defined.

(6) Given the tendency for some chlororganics to accumulate in wastewater treatment sludges, we must consider their mobility and fate during both land disposal and incineration of such sludges.

(7) Finally, there is a need for background level information for naturally occurring chlororganics, particularly if generic AOX-type measurements are to have any relevance.

Intertwined with all these information needs is the recognition that in the case of some chlororganics of current interest, we are working at the leading edge of trace compound differentiation and detectability, and with major disagreements over those trace levels at which significant bioresponse may occur. This is certainly the case for 2,3,7,8-dioxin where (a) changes in detectability over the past decade from the ppb to the ppt level brought it to centre stage for our industry, and (b) national assessments of acceptable daily intake levels range from 0.006 to 10 pg per kg body weight per day, or a range in acceptability from one country to another of over 1000, with the most restrictive limitations in force in the United States.

Research and data assembly is proceeding in all the listed areas on an international scale, as is the development of new regulations. This was quite evident at this conference two years ago. The timeframe within which we are working in the United States, the practical importance of the questions being addressed, and their contentiousness guarantee that there will be much to report two years hence. We hope by then that the newer knowledge will be integrated into a more coherent system, and look forward to again sharing an American perspective with you at that time.