Water Environmental Quality Standards

Requirements must fit the objectives

In July 2006, the EU Commission published a proposal for a Directive on Environmental Quality Standards (EQS) as required under article 16 of the Water Framework Directive (2000/60/EC) (WFD). Specifically, the Commission has now identified a list of 33 substances of concern (Table 1—from Annex 2 of the Directive), for which measures should be taken for '… the progressive reduction and, for priority hazardous substances, … the cessation or phasing out of discharges, emissions and losses.'

Table 1[1] **Priority Substances (PS) and Priority Hazardous Substances (PHS)**

Alachlor	Naphthalene
Anthracene	Nickel and its compounds
Atrazine	Nonylphenol
Benzene	*(4-(para)nonylphenol)*
Brominated diphenylether	Octylphenol
Cadmium and its compounds	*(Para-tert-octylphenol)*
Chloroalkanes, C10-13	Pentachlorobenzene
Chlorfenvinphos	Pentachlorophenol
Chlorpyrifos	Polyaromatic hydrocarbons
1,2-Dichloroethane	*(Benzo(a)pyrene)*
Dichloromethane	*(Benzo(b)fluoranthene)*
Di(2-ethylhexyl)phthalate (DEHP)	*(Benzo(g,h,i)perylene)*
Diuron	*(Benzo(k)fluoranthene)*
Endosulfan	*(Indeno(1,2,3-cd)pyrene)*
(Alpha-endosulfan)	Simazine
Fluoranthene	Tributyltin compounds
Hexachlorobenzene	*Tributyltin-cation*
Hexachlorobutadiene	Trichlorobenzenes
Hexachlorocyclohexane	*(1,2,4-trichlorobenzene)*
(Gamma-isomer, Lindane)	Trichloromethane
Isoproturon	*(Chloroform)*
Lead and its compounds	Trifluralin
Mercury and its compounds	

Where groups of substances have been selected, typical individual representatives are listed as indicative parameters.

Issues

There are several areas of concern for the refining industry and the first is the concept of cessation. According to the current proposal, mercury, cadmium and polycyclic aromatic hydrocarbons (PAHs) will have to be eliminated from refinery effluents—even though these substances occur naturally in receiving waters and in crude oil. Therefore, emitters will be required to continually reduce emissions until complete phase out over a 20-year period. At the endpoint, phase out and cessation is considered to be absolute zero and not a discharge level below a detection limit or a negligible load.

We believe the cessation concept, as defined above, is fundamentally flawed. Ever more sophisticated analytical techniques can detect chemical compounds at extremely low levels that the best available and most comprehensive treatment schemes cannot be expected to match. Even if a refinery could install a complete water recycling and reuse system, there would still be some release of concentrated materials which, while volumetrically lower than discharges from a conventional wastewater treatment system, would still not achieve an absolute zero emission. Furthermore, any reduction in effluent concentrations simultaneously increases the amount of waste produced and requires an increase in the amount of energy needed for additional treatment. In certain site-specific circumstances, this trade-off may in fact be more detrimental to the environment.

Some already appear to be taking a more pragmatic approach to this matter and recognise that it is impossible to prevent all emissions of naturally occurring substances, and to distinguish between their natural occurrence and man-made discharges where they overlap. Consequently, some Members of the European Parliament (MEPs) as well as several Member States have proposed amendments to this effect. They acknowledge

[1] *Proposal for a Directive of the European Parliament and of the Council on environmental quality standards in the field of water policy and amending Directive 2000/60/EC, Annex 2, pages 23–25, Brussels, 17.7.2006*

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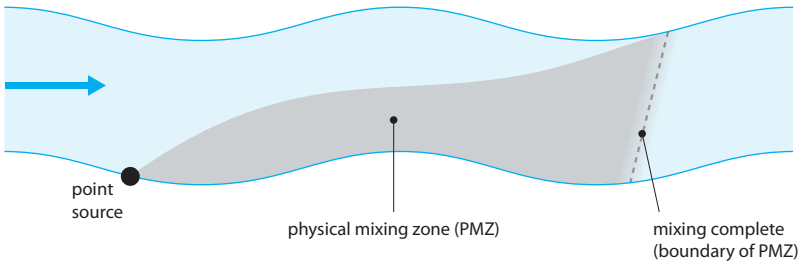
Figure 1[2] Point discharge mixing zone



the fact that the complete phase out of naturally occurring substances, such as cadmium, mercury and polyaromatic hydrocarbons, is impossible. But it is important for all Member States to recognise this, so that the original WFD requirements are translated into feasible objectives, which are not disproportionately costly and which achieve real environmental benefits.

A second issue is the use of transitional areas of exceedance (TAEs), also known as mixing zones (i.e. the area where the effluent mixes with the receiving water). Emission Limit Values (ELVs) are set according to what the receiving water can naturally assimilate, so that, although discharges may have a higher substance concentration, final concentrations in the water body comply with the established EQS levels and the integrity of the water body as a whole is not impaired (Figure 1).

The Commission has proposed the use of TAEs, but there is significant pressure by some MEPs and several Member States to eliminate them. If they are eliminated, refineries will have to meet the EQS at the discharge point—which effectively makes the ELV permitted for the site equal to the EQS. This 'end of pipe' requirement would result in a significant increase in treatment costs, since dischargers would have to reduce their emissions by a factor of 10 to 100. Refineries may be required to install equipment that goes beyond current Best Available Techniques (BAT), as currently outlined in the Best Available Techniques Reference Documents (BATREFs) for the Integrated Pollution Prevention and Control Directive 96/61/EEC.

These reduced effluent emissions would provide little environmental benefit since discharges would be below the natural background concentration of the receiving water. This is potentially the case for metals and PAHs since both of these substances occur naturally. If achieving these discharge limits became cost prohibitive or not technically feasible, a refinery may be able to obtain a derogation at Member State level. This would, however, be issued on a case-by-case basis so that the onus would be on refiners to conduct both technical and economic research in order to generate the information necessary to make their case. Furthermore, different criteria for acceptance of derogations between Member States could result in an un-level playing field for industry throughout Europe.

To illustrate this point, CONCAWE reviewed the European Commission's EQS numerical values versus the World Health Organization's Guidelines for Drinking Water Quality. In all cases, the proposed EQS values are set equal to or well below concentration levels that are considered safe for human consumption (Table 2).

For cadmium, benzo(a)pyrene (a polycyclic aromatic hydrocarbon) and mercury the EQS is respectively 12, 14 and 120 times lower than the WHO recommended value. This means that, if TAEs are not permitted, a refinery would be required to discharge water with substance concentrations 10 to 100 times better than drinking water quality. This would require sophisticated treatment schemes, such as granulated activated carbon, ion exchange or membrane filtration systems to polish the effluent water prior to discharge. The World Health Organization indicates that for mercury, 'It should be possible to achieve a concentration below 1 µg/litre …'[3] but this is still 20 times higher than the proposed EQS. So even with the most advanced treatment systems, facilities may not be able to meet EQS values at the discharge point, nor should they, since there would be little environmental benefit from such stringent discharge standards. This also illustrates the technical infeasibility of the cessation concept.

[2] After *Colorado Department of Public Health and Environment, Water Quality Control Division, Colorado,* Mixing Zone Implementation Guidance, *page 6, April 2002.*

[3] *WHO* Guidelines for Drinking-water Quality, *First Addendum to Third Edition, Volume 1, Recommendations, Annex 4. Chemical Summary Tables, page 402, 2006.*

CONCAWE activities

In response to the proposed legislation, CONCAWE has undertaken a series of actions to help its members assess the full impact of this Directive.

A refinery effluent survey launched in October 2006 was an important first step. Though this questionnaire was primarily developed to gather information for the CONCAWE risk assessment programme in connection with the REACH regulation, it will also allow us to understand the current gap between refinery ELVs and the proposed EQSs. This information can then be used to inform CONCAWE members and assist them in preparing for future issues (e.g. by making necessary changes to their site analytical capabilities, developing monitoring regimes, and/or developing risk management plans in order to help them meet the EQS requirements).

A project is also being considered to review the economics associated with additional wastewater treatment options. The need for this information stems from the EU Commission's impact assessment which states that 'Approximately 40% of the costs identified are associated with the refineries sector.'[6] The Commission estimates it will cost the refining industry between 1–14 billion Euros (scenario dependent) over the next 20 years to meet EQS requirements[7]. The wide range of costs is directly related to the choice of discount factor and implementation timeline, but the message is clear: European refineries will have to install additional equipment or take operational measures to reduce their emissions of PS and PHS.

This economic assessment project is still being defined, but CONCAWE intends to review facilities with various treatment schemes and determine both the capital and operational costs associated with more advanced treatment or management options. The cost range in the Commission's assessment indicates a worst case scenario, but it will be prudent to verify their results to have a better understanding of the real financial impact on refinery operations.

CONCAWE has also begun participating in an EU Commission Working Group that will manage which PS and which PHS will be placed on the future EQS list. Currently CONCAWE is involved at management level, but has offered to participate on the technical level as well. The technical working group will be jointly managed by the Commission and the European Chemical Bureau and they have planned their first meeting in May 2007. A group of experts will recommend the specific criteria for additional substances to go on the EQS list that the Commission must deliver by 2009.

What the future PS/PHS list will consist of is not well understood at this stage. The major issue CONCAWE

Table 2 Comparison of EU EQS values versus WHO drinking water guidelines

Substance	WHO (drinking water guidelines, µg/l)[4]	EQS (EU Directive for inland surface waters, µg/l)[5]	Factor of difference
Alachlor	20	0.3	67
Atrazine	2	0.6	3.3
Benzene	10	10	equal
Benzo[a]pyrene	0.7	0.05	14
Cadmium	3	0.25	12
Chloroform (Trichloromethane)	300	2.5	120
Chlorpyrifos	30	0.03	1000
1,2-Dichloroethane	30	10	3.0
Dichloromethane	20	20	equal
Hexachlorobutadiene	0.6	0.1	6.0
Isoproturon	9	0.3	30.0
Lead	10	7.2	1.4
Mercury	6	0.05	120
Nickel	70	20	3.5
Pentachlorophenol	9	0.4	22.5
Simazine	2	1	2.0
Trifluralin	20	0.03	667

Note: the WHO guidelines are published in milligrams per litre (mg/l). These values were converted to micrograms per litre (µg/l) to ensure proper comparison with the EQS values (annual average), which are listed as µg/l in the EU proposal. Also, for cadmium, a range from < 0.08–0.25 µg/l depending on water hardness is listed in the EQS tables and 0.25 µg/l is used above since it calculates the lowest factor of difference between WHO and EQS values.

[4] *Ibid [3], pages 491–493*

[5] *Proposal for a Directive of the European Parliament and of the Council on environmental quality standards in the field of water policy and amending Directive 2000/60/EC, Annex 1, Column 4, pages 18–21. Brussels, 17.7.2006.*

[6] *Commission Staff Working Document, Impact Assessment; Proposal for a Directive of the European Parliament and of the Council on environmental quality standards in the field of water policy and amending Directive 2000/60/EC, Brussels, 17.7.2006, page 25.*

[7] *Ibid, page 26.*

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Refinery effluents may contain a complex mixture of organic and inorganic compounds.

envisages is the practicality of adding 30 to 40 more substances, as indicated by the Commission Working Group, to the existing list of 33. Today, it is very difficult to sample and analyse for individual substances at the sub-microgram per litre level in refinery effluents, because many current laboratory techniques do not provide the necessary level of detection. Adding substances to the list will only compound the problem. To close this gap, CONCAWE is considering a comprehensive study of laboratory testing and analysis of refinery effluents. The information gathered will help determine the shortfall in current procedures compared to what may be required under the EQS Directive and help CONCAWE member companies understand the issues associated with testing substances that traditionally may not be on an effluent permit, especially at very low concentrations.

Additionally, CONCAWE has studied the biological effects of refinery effluents and has done significant analysis of Whole Effluent Assessment (WEA) techniques. This research has provided great insight into the toxicity and biodegradation of refinery effluents. WEA is more cost-effective and looks at the actual environmental impact of an effluent, regardless of its constituents. CONCAWE contends that it is a preferred alternative to adding more individual substances to the EQS list. The EQS substance-by-substance approach will be costly, unmanageable and never really indicate what the potential environmental effects of these substances may be.

The way forward

It is vitally important that the outcome of the proposed Directive allows industry to take proportionate measures to reduce pollutants in effluent water where it is environmentally beneficial. While EQSs are intended to provide an indication of the environmental status of a water body, they may now become ELVs, which will require a great deal of investment in an attempt to meet more stringent discharge requirements. It is not pragmatic to reduce substances to levels well below drinking water guidelines, as this becomes very expensive and provides questionable environmental benefits.

Additionally, if it is not possible or pragmatic to reduce emissions below drinking water standards, then the concept of absolute cessation becomes futile. While the Water Framework Directive clearly establishes this concept, it does not define it and it would be prudent for any future legislation to clearly define that cessation is not absolute. Otherwise, emitters will be subject to a provision that is not achievable and the law will then fail to meet its intended objectives.

To this end, national and European-wide trade associations need to ensure that these messages are sent to decision makers, so that they develop any forthcoming legislation in a sensible manner. Refiners should also be aware that if the legislation passes in its current form, meeting more stringent emissions targets will be difficult if facilities have not done the proper analysis beforehand. Therefore, CONCAWE suggests that its member companies begin risk planning now rather than wait until the Directive is finalised (projected for 2008). While CONCAWE is doing its part by researching general topics that will help all member companies, individual facilities will have to understand site-specific gaps between current discharge levels and future emissions limits, so that they are not subject to undue higher costs and additional regulatory pressures at the last minute. The Water Framework Directive mandates that EQSs must be established for compounds selected by the Commission. Although full details are not finalised, it is better to be prepared for a possible step change in emissions targets by planning today.