Providing information and guidance on water and soil management

Understanding the aquatic ecosystem and demonstrating continual reduction of the refining sector's impacts

When CONCAWE was formed in 1963, the conservation of Europe's water resources was one of the main drivers, following the commitment made by the industry at the 6th World Petroleum Congress. Water remains an essential resource that has, over the years, come progressively higher on the international agenda because of its intimate relationship with both human health and ecosystem development. In the 50 years of CONCAWE's existence, water quality in Europe has improved steadily and the contribution of the refining sector to this improvement cannot be ignored. Today, almost 50% of Europe's surface and groundwater bodies are classed as being of at least 'good' status (as defined in the Water Framework Directive) and, for those that do not meet this standard, the impact of the refining sector has been shown to be minimal. Nevertheless there is growing pressure on water resources in terms of chemical and ecological quality, of the quantity used or consumed, and of equitable access to good quality water.

Water in oil refining: continuous improvement over the years

Like most heavy industries, oil refineries use large quantities of water, handling roughly six times more water than the quantity of crude oil they process. The industry has made important progress in reducing its water demand and improving the quality of its discharges into the environment, especially into fresh water systems.

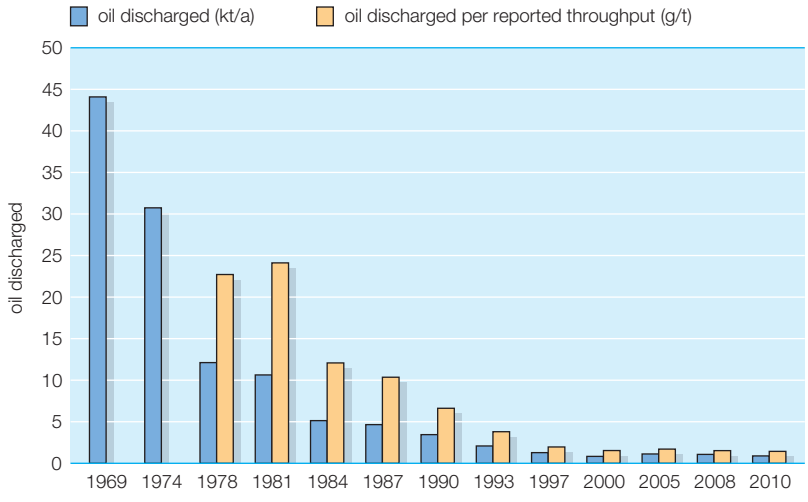
Effective management of water, from supply through handling and treating to final discharge into the environment, is a key requirement for the efficient and responsible operation of a modern refinery and a condition for its acceptance by the community.

The name CONCAWE includes 'clean water', one of the first issues dealt with by the Association. In the early years much work was devoted to reducing oil discharges from refineries. Figure 1 illustrates the evolution over the past four decades with reductions of more than 99% in the total oil discharged and 94% in the quantity of oil discharged per unit of crude oil intake[1]. This has been achieved through the installation of increasingly sophisticated treatment systems, which also allowed significant reductions in the discharge of oil and most other refinery pollutants. This represents a major success considering that the production volume has more than doubled and the refineries included in the analysis have broadened over time.

In 2010, the total amount of non-chlorine pollutants reported by the European refining industry to the European Pollutant Release and Transfer Register (E-PRTR) accounted for only 0.82% of total industrial discharges in the EU. In comparison, discharges by the urban waste water treatment (UWWT) sector accounted for 54% of the reported load[2]. This is a clear demonstration that today's environmental issues are no longer dominated by the activities of heavy industry in general, and the refining industry in particular.

As the level of pollutants discharged has reduced, the focus of attention is shifting towards minimising the impact of industrial water usage on the environment, specifically where this concerns fresh water use and consumption. The refinery sector's water intakes, discharges and fresh water consumption are presented in Figure 2, as reported in 2010. Although considerable amounts of water are associated with refinery opera-

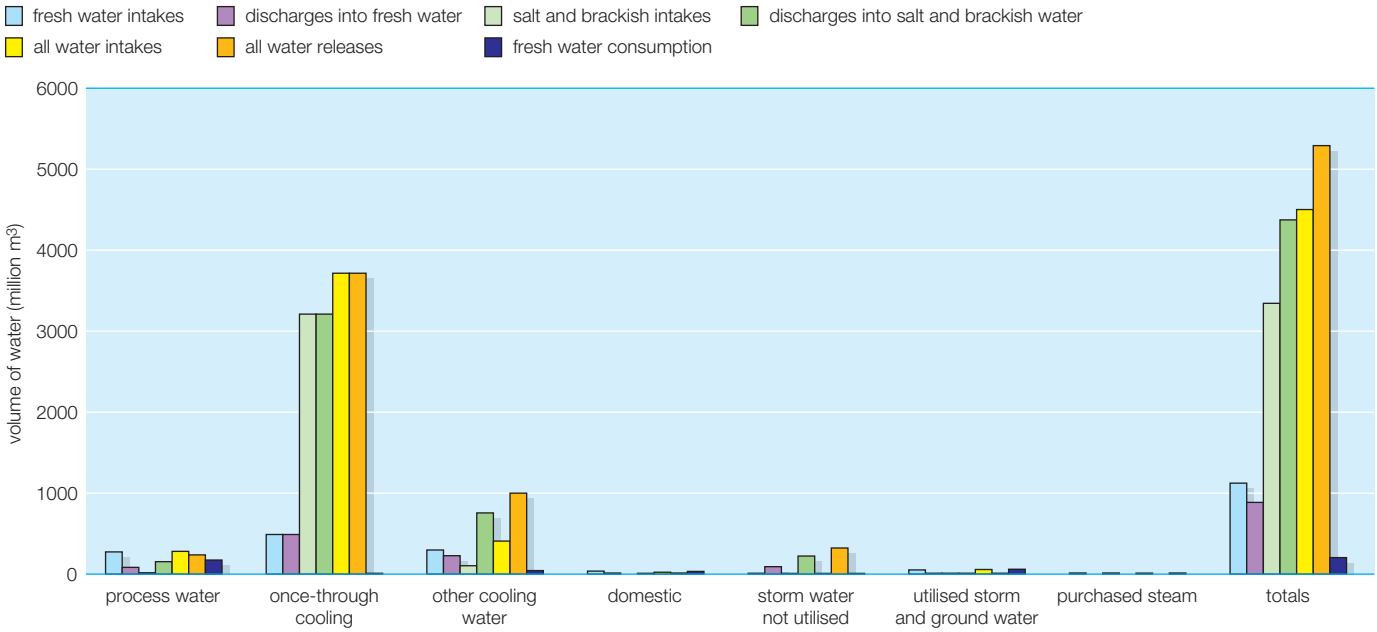
Figure 1 Oil discharged from refineries in Europe



[1] CONCAWE report 6/12

[2] In our studies, the entire refining sector has reported, while, for the UWWT, only larger installations (> 100,000 p.e.) have to report their emissions covering less than 50% of UWWT discharges. For this reason, the reported amount from the refining sector is representative of at most 40% of the total load from UWWT discharges.

Figure 2 Refinery sector water intake, discharges and fresh water consumption, 2010

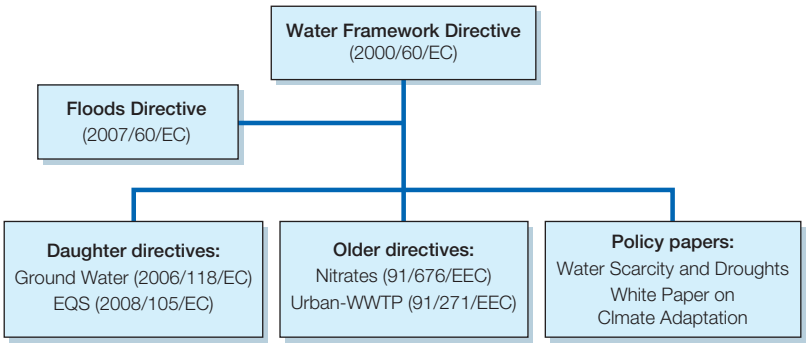


tions, the total fresh water consumption (that is, the volume of water that will no longer be available to other users after discharge or use) is now 225 million m^3 or, on average only 0.31 m^3 per tonne of crude oil processed. In 1969, a similar survey showed that this figure was 8 m^3 per tonne of crude oil processed, evidence that the refining sector has succeeded in significantly reducing its fresh water footprint, contributing to more sustainable water use.

The European regulatory framework

In 2000, the Water Framework Directive (WFD, 2000/60/EC) was adopted, drawing together related but hitherto separate pieces of European water legislation. This comprehensive piece of legislation covers water resources, water quality and hazardous substances and provides an integrated approach to water management. Water quality is defined both in conventional chemical terms and also in terms of ecological quality. Since the Directive was enacted in 2000, several daughter and supportive directives and policy papers have been adopted and published. These, and some earlier directives, comprise the EU water policy framework that is depicted in Figure 3. The WFD is implemented through a Common Implementation

Figure 3 The EU water policy framework



Strategy (CIS) that sets out the techniques and requirements for achieving its expectations, by developing Commission guidance on specific topics and by scientifically assessing the available information for setting Environmental Quality Standards (EQSs).

As part of the European 'Year of Water' in 2012, a major water policy fitness check was performed, which concluded that the framework is still robust enough to deliver the desired water quality and quantity. However, meeting the framework's expectations is proving more difficult mainly due to non-compliance and poor imple-

mentation by Member States. The review also identified a lack of robust data to demonstrate progress.

The fitness check was an important step leading to a 'Blueprint to Safeguard Europe's Water Resources'. According to the Commission, the quality of EU waters is not improving rapidly enough and additional policy measures are needed to accelerate progress and to ensure the equitable availability of water of the desired quality. Moreover, the Blueprint places strong emphasis on ecosystem functioning, indicating the need to halt biodiversity loss and, where possible, initiate reversal of biodiversity losses already observed. It also includes the management and utilisation of the essential ecosystem services that can only prosper in sufficiently diverse ecosystems.

To achieve these goals, the Blueprint and the Policy Fitness Check clearly indicated that the policy framework alone is insufficient. However, the legislative toolbox does not require more instruments—these are already in place. There is extensive legislation mentioned in support of the water policy framework objectives, including: the Strategic Environmental Assessment (2001/42/EC) and Impact Assessment (85/337/EEC) Directives that require an evaluation of impacts of future investments or installation changes; the Marine Strategy Framework Directive (MSFD, 2008/56/EC—the marine equivalent of the WFD); and the Habitat (92/43/EEC) and Birds (2009/147/EC) Directives that should deliver the target of no net loss of biodiversity. Furthermore, the Environmental Liability (2004/35/EC) and Environmental Crime (2008/99/EU) Directives enable funding of restoration by, and prosecuting of, the polluter. The Industrial Emissions Directive (IED, 2010/75/EU) addresses pollution by industrial point sources and the REACH Regulation, the Plant Protection Products and Biocides legislation regulates substances that might contribute to impacts on water quality. Finally, the EU climate policy framework and the Renewable Energy Directive (RED, 2009/28/EU) also address water issues.

CONCAWE has invested considerable effort in supporting implementation of the WFD, contributing to several guidelines and ensuring that EQSs were only derived for substances that require EU-wide standards, and that these reflect the latest ecotoxicological data on those substances. By providing monitoring and effect data, only a few refinery-relevant substances remain on the priority list that was adopted in 2008. The revision of this list is now in the legislative process for adoption by the Council and the Parliament. Similar activities have been performed with respect to the implementation of the EU Groundwater Directive. Furthermore, contributions were made to the CIS guidance on mixing zones and emission inventories.

Industrial emissions, including those of the refining sector, are subject to the Integrated Pollution Prevention and Control Directive (IPPC) that considered the use of Best Available Techniques (BAT) to optimise resource use, minimise pollutant generation and control discharges in the major industrial sectors. Since its adoption in 1996, this Directive was updated in 2008 and replaced by the IED in 2010. Although its scope is much wider, water use and effluent quality are amongst the key issues addressed by the IED. The 'European IPPC Bureau', established in Seville, has been given the task of preparing and/or reviewing the BAT Reference documents (so-called 'BREFs') for all the industries covered by the IED. The BREF BAT conclusions under the IED, unlike the IPPC, are given a legally binding status for the derivation of permit conditions and emission limit values.

In 2008 the review of the 2003 Refinery BREF (REF BREF) was initiated, which meant that CONCAWE acted on behalf of the refining industry in the Bureau's Technical Working Group (TWG), providing significant technical input, both as actual performance data and operational experience. Given the change in status under the IED of the BAT conclusions, the first challenge was to define what would constitute BAT for refineries, what emissions these technologies could be expected to produce and what their costs would be. In 2011, CONCAWE carried out a comprehensive refinery effluent survey building on earlier work performed in 2006 and 2009, that proved to be an extremely useful source of information during the BREF drafting and commenting process. The full results of this survey covering the year 2010 will be published in 2013.

The revision of the REF BREF is still ongoing and CONCAWE provided extensive comments (500 from a

total of 1248 received by the Bureau) on the last draft document. In early 2013, a final meeting of the TWG will be held, where CONCAWE, supported by member company experts, will express their views on the comments that were accepted or rejected by the Bureau, to ensure that the REF BREF is a balanced technical document.

A similar but less arduous process is under way for the review of the so-called horizontal BREF document from 2003 on Common Waste Water and Waste Gas Treatment Systems. CONCAWE has made a significant contribution in several areas related to our industry sector. Although labelled a Chemicals BREF, this horizontal BREF is intended to apply to a range of industry sectors. However, a number of the topics covered are also mentioned within the Refinery BREF. CONCAWE's involvement in the review process is aiming to ensure that areas relating to the refining sector are exclusively covered by the REF BREF and that these are tailored to our sector's performance and capabilities.

Convention for the Protection of the Marine Environment of the North-East Atlantic (the 'OSPAR Convention')

OSPAR remains an important actor on the European marine water scene, as it deals not only with the seas but indirectly with all main water basins discharging into the North Sea or Eastern Atlantic. As a direct result of the large reductions in oil discharged by refineries as indicated by the CONCAWE data, OSPAR decided a few years ago that refineries should now have a low priority and discontinued their specific refinery effluent surveys. OSPAR still request CONCAWE data to monitor the status, and these data are regularly reported in the effluent survey reports.

OSPAR is leading the development of biological effects measurements to understand the impacts of aqueous discharges on the environment. Such an approach seeks to monitor effects either directly upon the environment (e.g. studies of population effects or species diversity) or using surrogates for the environment (e.g. test species with response to certain stimuli or stresses resulting from the presence of pollutants). This approach is also now being more commonly adopted within Member States and the EU itself (particularly in the WFD). CONCAWE has participated in the OSPAR expert group on whole effluent assessment (WEA) and has carried out a demonstration programme on the applicability of WEA methods to real discharges. The methodologies being evaluated could become a standard part of future legislation both for OSPAR and the EU, covering virtually all European countries. WEA is a tool whereby a sample of effluent is assessed against a range of biological tests (potentially covering e.g. acute and chronic toxicity, potential to bio-accumulate, persistence and some genetic effects) to assess whether the effluent may cause harm to the environment. There are many questions unresolved as yet on the efficacy of this type of testing, which could potentially lead to very stringent requirements for effluent control. CONCAWE is bringing data from member company studies into the debate, particularly in the areas of persistence and potential for bioaccumulation[3].

There is no doubt that the introduction of biological effects measurements, in addition to the more traditional chemical-specific approaches currently used to regulate refineries, will cause different issues to become a priority. It is argued that such an approach more closely addresses the actual impacts upon the environment. It is also a potential benefit to operators, allowing a more readily acceptable demonstration of no harm to the environment. The key issue is whether the measurements made in a laboratory relate to real environmental effects in the receiving water. This is particularly so for some of the longer-term chronic and genetic tests where the relation to actual population effects is not always clear. This could lead to significant changes to effluent control systems which may not achieve real environmental improvements.

Soil and groundwater remediation

Besides direct water issues, CONCAWE's Water and Soil Management Group (WSMG) has also focused on the assessment and clean-up of contaminated land, because of the potential impact on groundwater resources. WSMG published guidelines for a risk assessment-based method for determining whether there is a need to clean up contaminated sites and, if

[3] CONCAWE report 1/12

so, what standards should be used for evaluating the final level of contaminants. These guidelines have recently been revised and expanded. During the 1980s CONCAWE also published a series of field guides on oil spill control. Although these date back more than 20 years, much of the information is still relevant and the guides remain an acknowledged and valuable resource in this area, frequently requested by member companies and third parties.

In addition, CONCAWE has published a sensitivity study on retail stations in several European Countries[4] and a study on the behaviour of Gasoline Ether Oxygenates in the environment in support of site remediation strategies in case of fuel spills[5].

Outlook

From Rio (1992), via Johannesburg (2002) through the Rio Earth Summit in 2012, debate on sustainable development has focused on water as an essential resource for life, shifting attitudes to water in a manner not applied to most other raw materials. The EU has taken a positive lead in the debate on water resources and indeed the WFD opens with the phrase 'Water is not a commercial product like any other but, rather, a heritage which must be protected, defended and treated as such'. The IED Directive mentions ensuring prudent management of natural resources and uses water as one of its examples, specifically requiring operators to take measures to use water effectively within their installations.

Although the quality of Europe's waters has experienced significant improvements, the conclusions of the Blueprint, the Policy Fitness Check and the desire to align the MSFD with the WFD is likely to stimulate many implementation initiatives to demonstrate that the targets are met. These will most likely affect the Member States, who will turn to industry even though the facts show that industry is not the major contributor to today's environmental issues.

Moreover, water resources remain under pressure in Europe. Agriculture and households appear to be the larger water users in most areas, but industry also plays a significant part. Water remains essential for efficient refinery operation and some refineries can be large local users of water. It is important that all sectors work together to understand and manage the local and regional water supply and quality issues and ensure that the equitable use perspective advocated in the Blueprint is resolved by mutual agreement rather than by regulatory action.

CONCAWE's activities in the areas of water cover a range of environmental and operational issues within the refining industry, ranging from water supply and resource management through operational optimisation to minimisation of waste generation and environmental impact. The information generated through surveys and studies continues to be recognised by both the industry and third parties, including regulators, as a valuable contribution to the ongoing debates. As water has risen up the political agenda the importance of this contribution can only increase.

In response to the EU's biodiversity aspirations, the refining sector should continue to integrate biodiversity and ecosystem services management into its strategy and daily operations. CONCAWE, through WSMG, will support its members in this activity.

[4] CONCAWE report 1/11

[5] CONCAWE report 4/12