Refinery sulphur emission reductions reflect the different regional needs

SO_2 emissions legislation and the north/south divide

Since the late '70s, CONCAWE has conducted three-yearly surveys of its Member Companies to provide detailed data on sulphur in crude oil and petroleum products, and sulphur emissions to air. The most recent survey, covering the year 1998, includes data from 79 European refineries processing about 87% of the Western European crude oil. The results, soon to be published in a CONCAWE report, show continued decrease of refinery SO_2 emissions and increase of global sulphur recovery as the European refining system has responded to legislation on emissions and product quality. It establishes a new baseline for comparisons with future performance as further legislation affecting refineries and their products is enacted.

In this brief article we focus on the sulphur emissions to air from the reporting refineries and compare the results of the 1998 survey with those of 1992 and 1995. In particular, we examine the trends in refinery 'combustion bubble concentration'[1] of SO_2 in the light of concerns over acidification in the EU.

In Europe there is continued pressure for environmental legislation to reduce SO_2 emissions. The main drivers for such legislation are air quality improvement and control of acidification. Given the general attainment within Europe of the air quality standards for SO_2 designed to protect public health, acidification has become the more important of these two issues.

Partly in response to these concerns over acidification, the European Union recently adopted the National Emission Ceilings Directive (NECD) and the The United Nations Economic Commission for Europe (UN-ECE) promulgated the multi-pollutant/multi effects Protocol known as the Gothenburg Protocol.

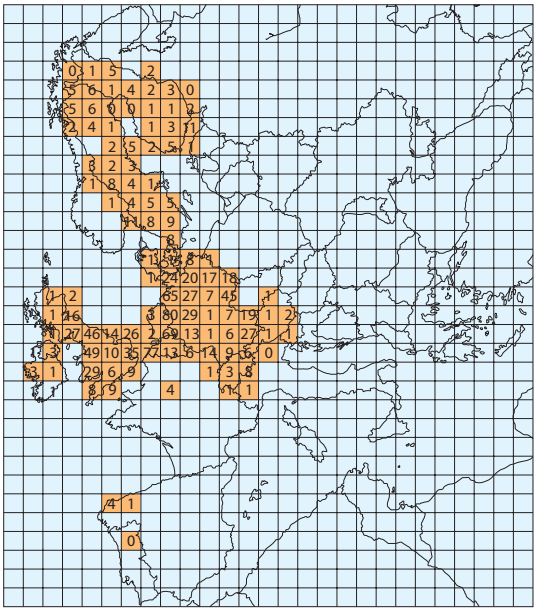
The technical work underpinning both the NECD and the Gothenburg Protocol highlighted the significant differences in the severity of acidification problems across Europe. In particular this showed that northern Europe experiences much more severe problems than southern Europe due to its more vulnerable ecosystems. This is clear from Figure 1 which shows the percent of ecosystems that are foreseen to be exceeding their acid critical loads in 2010 assuming that the measures legislated prior to the NECD and the Gothenburg Protocol are implemented.

This 'north-south' divide is reflected in the more demanding SO_2 emission ceilings for northern European countries in both the NECD and the Gothenburg Protocol. This is mirrored in the regional differences in SO_2 bubble concentrations as well as in the differing regional trends in bubble concentration since 1995.

For the total of the surveyed refineries, the average sulphur content of the refinery fuel oil burned decreased from

Figure 1

Percent of ecosystems exceeding their acid critical load in 2010

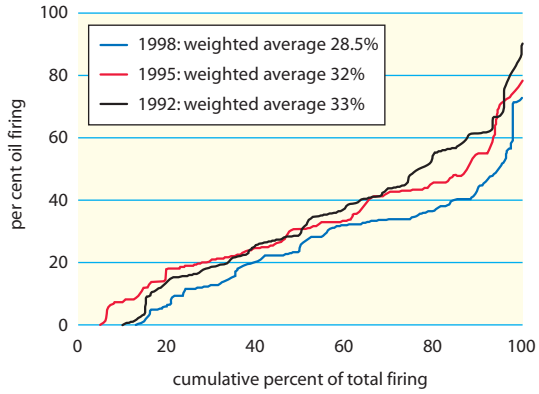


[1] *The combustion bubble concentration of SO_2 is defined as the total amount of sulphur dioxide emissions (mass) from all the combustion plants in a given refining site divided by the total amount of flue gas emitted (Normal cubic metres) by those combustion plants, assuming an excess oxygen content (dry basis) of 3%.*

Refinery sulphur emission reductions reflect the different regional needs

SO_2 emissions legislation and the north/south divide

Percent of all oil firing in refineries
(all reporting refineries)



Sulphur content of refinery fuel oil
(all reporting refineries)

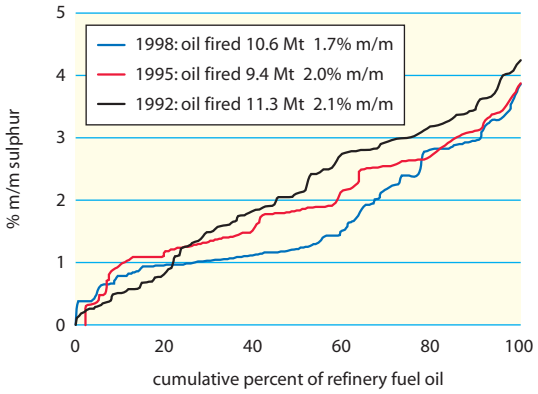
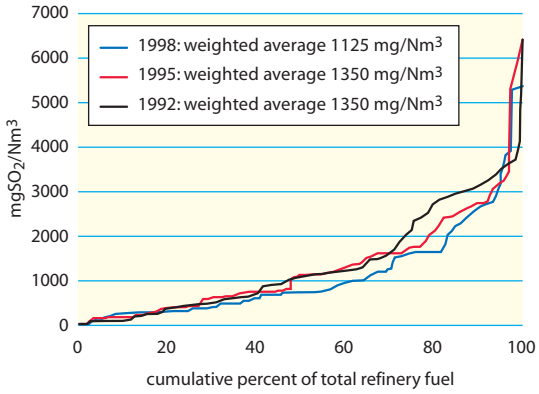


Figure 2 (left)
The percentage of fuel oil burned dropped from 32% in 1995 to 28.5% in1998.

Figure 3 (right)
The average sulphur content of refinery fuel oil burned decreased from 2.0% in 1995 to 1.7% in 1998.

SO_2 bubble concentrations from oil/gas firing
(all reporting refineries)



SO_2 bubble concentrations from oil/gas firing
(by region for 1998)

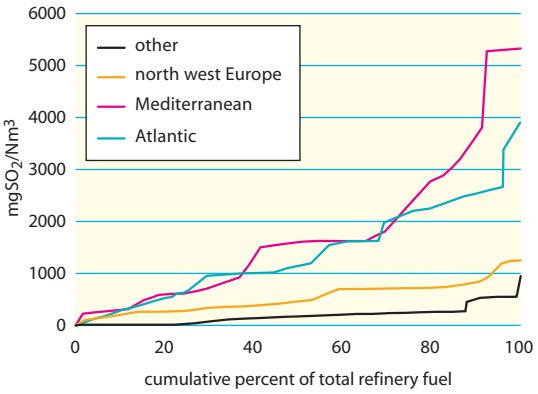


Figure 4 (left)
The average refinery SO_2 combustion bubble decreased from 1350 mg/Nm^3 in 1995 to 1125 mg/Nm^3 in 1998.

Figure 5 (right)
The 1998 data from Figure 4 is presented here by region, and reflects the tougher SO_2 ceilings for northern European countries.

2.0% in 1995 to 1.7% in 1998 while the percentage of fuel oil burned dropped from 32% in 1995 to 28.5% in 1998. The distribution across all reporting refineries is shown in Figures 2 and 3.

This resulted in a significant decrease in the average refinery SO_2 combustion bubble, from 1350 mg/Nm^3 in 1995 to 1125 mg/Nm^3 in 1998. The distribution of bubble concentrations across the surveyed refineries is given in Figure 4. In order to visualize the regional differences, the data are shown by region in Figure 5[2]. This clearly highlights the impact of the more severe acidification problems in northern Europe. This is perhaps even more clearly seen in the regional changes in refinery bubble concentration since 1995.

In north west Europe the average refinery SO_2 bubble concentration of about 860 mg/Nm^3 in 1995 dropped to 550 mg/Nm^3 in 1998, a 36% reduction. In contrast, the Mediterranean region average was much higher at 2060 mg/Nm^3 in 1995 and reduced by a more modest 9% to 1870 mg/Nm^3 in 1998. As discussed above, such regional differences are consistent with the more severe acidification problems in northern Europe compared to southern Europe and are reflected in the tougher SO_2 ceilings for northern European countries in the recently adopted EU National Emission Ceilings Directive and the UN-ECE Gothenburg Protocol.

[2] *The four regions used in the report have been defined to be representative of areas and countries which are similar in terms of crude supply and product demand pattern. They are: north west Europe (Belgium, The Netherlands, Germany and Denmark); Atlantic (Ireland, United Kingdom, Portugal and the Atlantic coasts of France and Spain); Mediterranean (the Mediterranean coasts of Spain and France, Italy and Greece); 'Others', namely the former EFTA countries (Norway, Sweden, Finland, Austria and Switzerland) and Hungary.*