AIR QUALITY MONITORING, ASSESSMENT AND MANAGEMENT AT PORT TALBOT, UK

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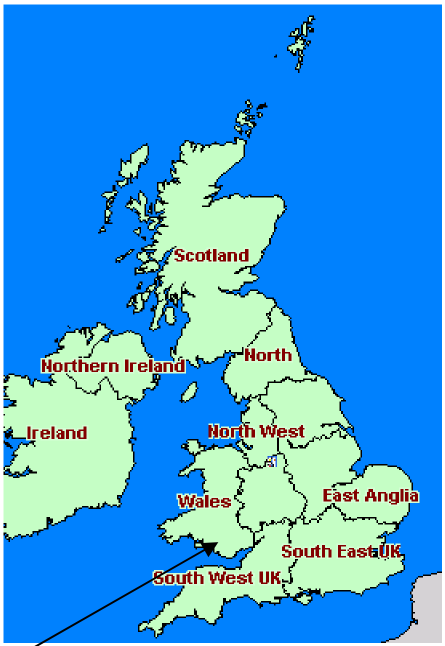
ABSTRACT

A series of monitoring campaigns of PM_{10} using automatic cartridge collection unit and TEOM systems were carried out at Port Talbot, Wales, UK during the period 1997 to 2001. Air quality modelling exercises and fingerprinting using sample analysis were also conducted. This study was the first of its kind in the UK Air Quality Review and Assessment process. Its aim was to identify the causes of exceedance of the National Air Quality Objective for PM_{10} at Port Talbot, so that an Air Quality Management Area Action Plan could be formulated. In the investigation of source apportionment of PM_{10}, contributions from both local sources and transboundary pollution were assessed. Local sources including traffic, point and fugitive emissions from an integrated iron and steel works, and sea spray were examined. Directional monitoring, together with modelling, has enabled reliable estimates of contributions from different sources to be made. Fugitive emissions from a blast furnace at a local integrated iron and steel works were found to be the major contributor to the measured PM_{10} peak levels. Different potential control measures were proposed to reduce PM_{10} emissions from the furnace and modelling was used to assess the air quality impact of these abatement scenarios. Based on the results of this study, the steel works and the Environment Agency were able to agree improvement measures as part of the Local Authority's Air Quality Management Area Action Plan to ensure that the National Air Quality Objective of PM_{10} is likely to be met by 2005.

INTRODUCTION

Under Part IV of the Environment Act 1995, local authorities have to carry out an air quality review within their area and assess whether the air quality objectives as prescribed by the Air Quality Regulations 2000 are likely to be met. In places where any of the air quality objectives are not likely to be achieved by 2005, the local authorities will have to designate Air Quality Management Areas (AQMAs) and prepare air quality action plans.

In their reviews of air quality at Port Talbot, Neath Port Talbot County Borough Council found that the air quality objective of PM_{10} was exceeded in the Taibach and Margam area (see Figure 1). An Air Quality Management Area (AQMA) would need to be declared (highlighted in green). In order to prepare an action plan to meet the air quality objectives, it would be necessary to identify the contribution of PM_{10} from specific sources.



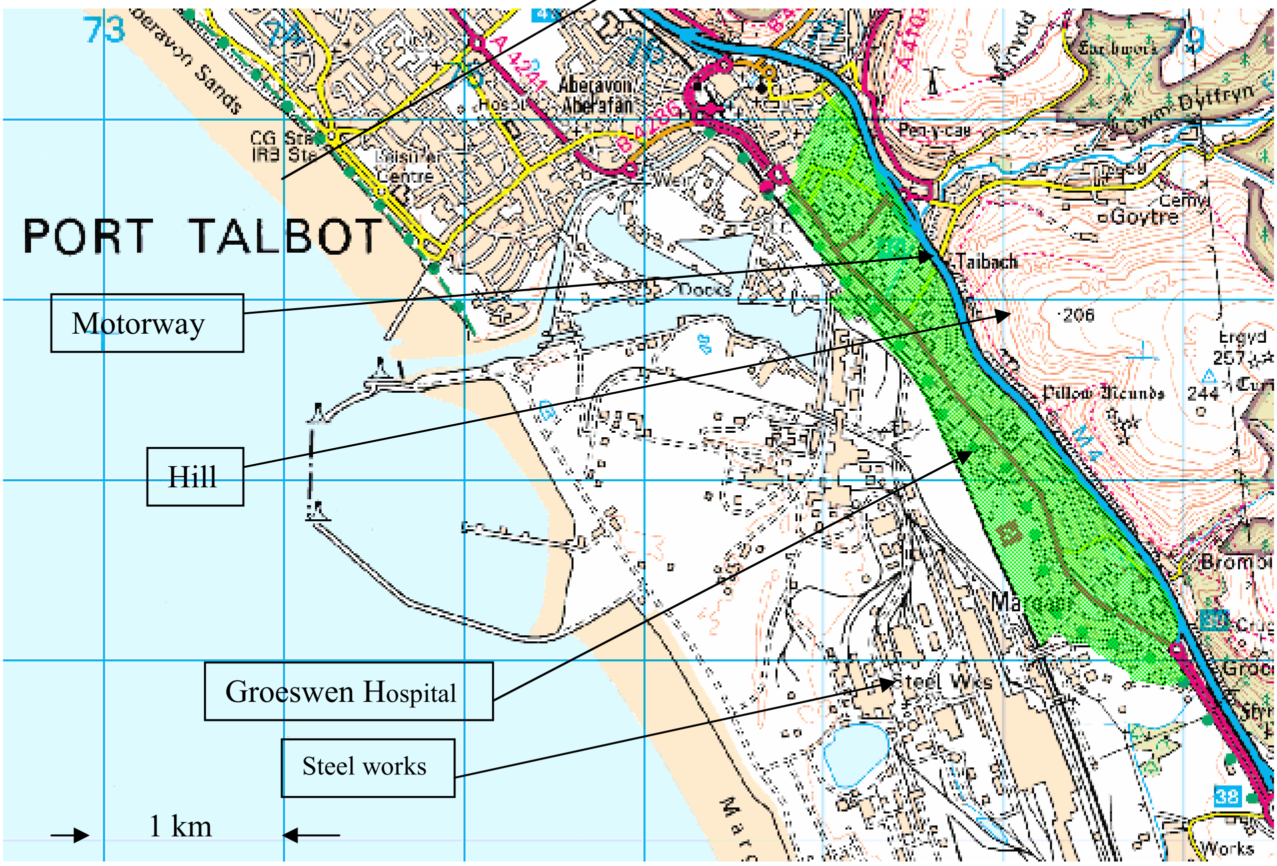


Figure 1. Location of Port Talbot.

IDENTIFICATION OF SOURCES

Since 1997, a series of studies have been carried out to identify the contributions from different sources.

Sea Spray contribution

Comparison of PM_{10} measurements made between Port Talbot (Groeswen Hospital) and Swansea City Centre, another coastal location only about 14 km away, suggested that sea spray was not the main factor for the exceedance of the air quality objective of PM_{10} at Port Talbot. It was found that the exceedance of the air quality objective at Port Talbot arose as a result of a series of pollution peaks, rather than a generally raised pollution level. Figure 2 shows a time series of PM_{10} concentrations measured at Port Talbot and the Swansea City Centre.

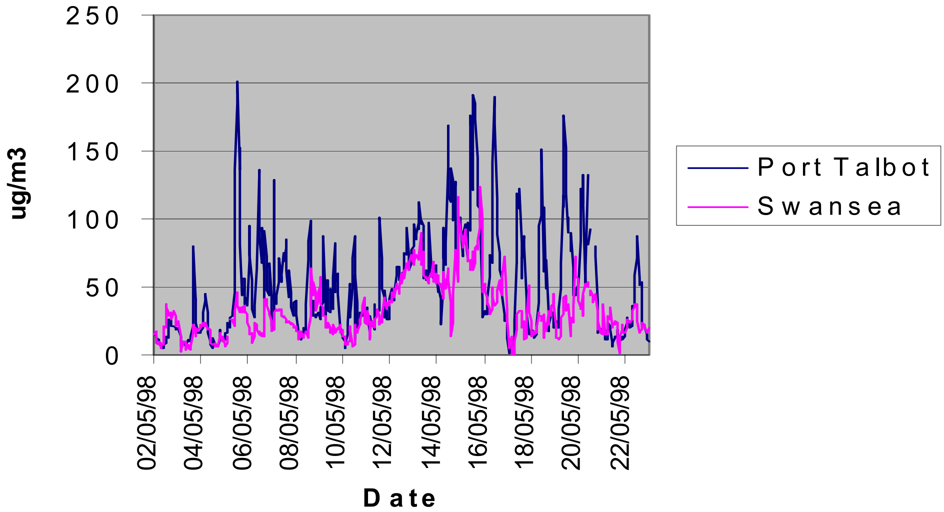


Figure 2. Time-series comparison of hourly averaged PM_{10} concentrations.

Chemical component analysis

Several studies were carried out in order to characterise the PM_{10} pollution and determine its sources. The first such analysis identified the presence of iron flyash, especially in samples from the south-west. The flyash particles were in the range 0.2 to 3 μm, heavily weighted towards the fine end of the distribution.

The results produced from a further investigation were broadly similar to those of the previous study, confirming that iron flyash could comprise the majority of insoluble particles (by count) in the south westerly direction. Angular iron particles were identified as minor components.

Three further separate studies were carried out. Some selected results are shown in Table 1 and Figure 3. The results were characterised by a high proportion of soluble material (see Table 1). The analysis from four sets of measurements shows that the highest PM_{10} levels were found in the south and south-west sectors for both soluble and insoluble components. At moderate pollution, the main contributor to the inorganic insoluble component was found to be iron oxide; the main contributors to soluble anions were chlorate and sulphate. The third study comprised the analysis of TEOM filters and the comparison of these samples from different parts of the Corus steel making process, blast furnace, basic oxygen steel (BOS) making plant, sinter plant and coke oven operations. The study again revealed the presence of spherical iron oxide particles in the TEOM filter samples. The majority of these particles were found to resemble materials that had originated from the blast furnace emissions.

Table 1. Chemical component analysis results from 4 sets of 15-minute measurements at Groeswen Hospital, two were carried out at Low PM_{10} pollution level and two at Moderate PM_{10} pollution level.

PM_{10} components	**Low PM_{10} pollution level* (% of total PM_{10} averaged over all sectors)**	**Moderate PM_{10} pollution level* (% of total PM_{10} at SW Sector)**
Soluble	82-93 %	60-63%
Insoluble	5-13%	26-30%
Elemental carbon	2-5%	11-12%

*Low and moderate PM_{10} pollution levels were defined based on the DETR (Department of Environment, Transport and Rural Affairs) air quality system.

Source identification and monitoring pollution roses

In 1998/9 two further PM_{10} monitors were employed to gauge the area affected by the PM_{10} exceedances. An analysis of the measurement results suggested that the area affected by the PM_{10} pollution was quite localised.

Analogous to the concept of a wind rose, a "pollution rose" was used in this work. Visual inspection of the pollution rose measured in 1998 at Groeswen Hospital showed that the greatest PM_{10} concentrations were observed in the direction of the blast furnaces of the Corus site.

A further study was carried out by placing a monitoring station on land near the sea on the south-western edge of the works. Figure 4 shows the results of a 9-month TEOM (Tapered Element Oscillating Microbalance) measurement in 2001. Visual inspection of the pollution roses in Figure 4 shows that both sites have the highest PM_{10} contributions from the steel works direction. It is concluded that sea salt, transboundary pollution and road traffic are unlikely to be the dominant sources.

While Corus thought that material stockpiles and roadways might have been significant sources of insoluble iron the work of the Agency and County Borough Council established this was not the case. The majority of the iron particles in the TEOM samples had undergone some form of heating process and were considered typical of particulates arising from blast furnace operations.

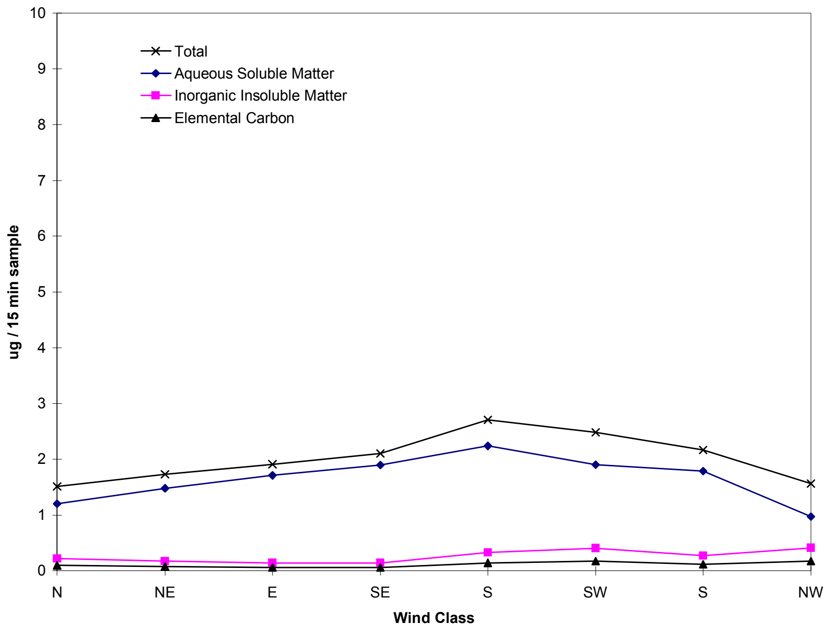
Dispersion modelling study

Modelling of air quality impact due to PM_{10} emission at the steel works were carried out by both the Environment Agency and Corus. Both studies found that the Blast Furnace Number 5 (BF5), which had no cast-house arrestment, made a significant contribution to PM_{10} pollution at Groeswen Hospital.

Different abatement conditions were also modelled to inform discussions between the Agency and Corus on possible improvement measures.

Conclusions

Blast Furnace emissions from the local steel works were responsible for the majority of the insoluble particle measured at Groeswen Hospital. Results from chemical components analysis showed that aqueous soluble particles are the majority component overall. The local steel works was the main contributor to the PM_{10} at the declared AQMA area.



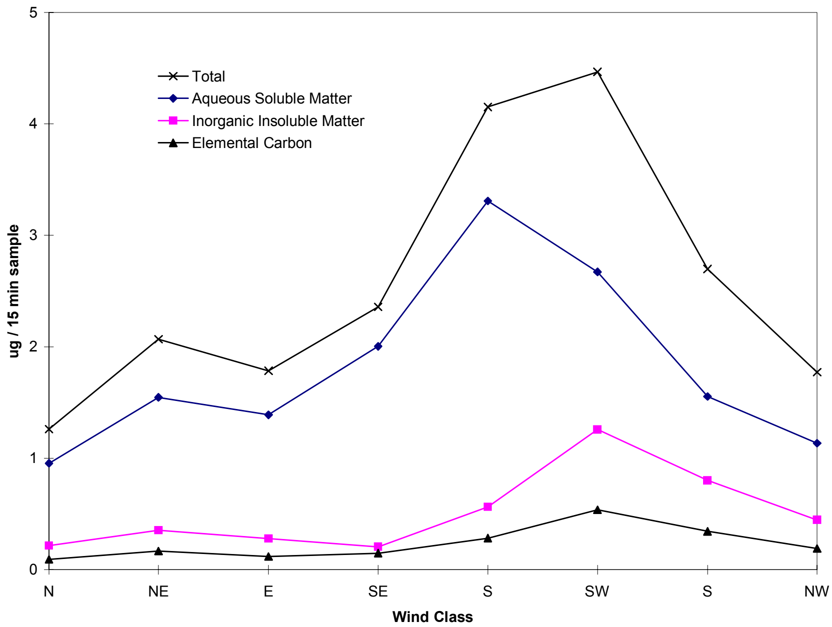


Figure 3. PM_{10} chemical components measurements at Groeswen Hospital.
Upper: PM_{10} components measured at low PM_{10} pollution level;
Bottom: PM_{10} components measured at moderate PM_{10} pollution level

CURRENT AIR QUALITY MANAGEMENT

Based on the results of this study, the steel works and the Environment Agency were able to agree improvement measures as part of the Local Authority's Air Quality Management Area Action Plan to ensure that the air quality objective of PM_{10} will be met by 2005. As a first step, Corus has replaced the Blast Furnace Number 5 and at the same time, installed a cast house fume arrestment for particle abatement.

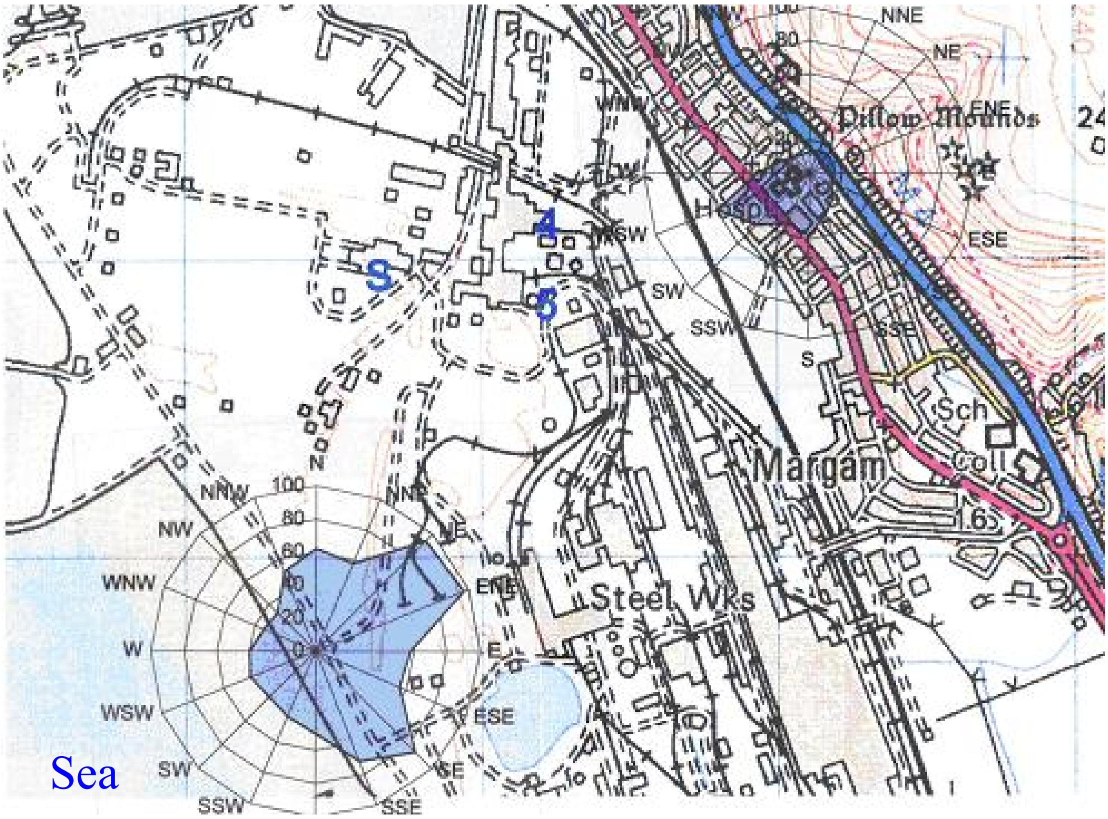


Figure 4. Two measured particle pollution-roses. The bottom one was sited on land near the sea-shore; the upper one was located at Groeswen Hospital.

The continued TEOM measurements of PM_{10} at Groeswen Hospital since November 2001 (when the old BF5 ceased operation) have shown a somewhat reduced number of exceedances. However, there are over 50 release points on the site, and monitoring results at Groeswen still show exceedances. The conversation factor of 1.3 used for TEOM measurements correction is an issue with uncertainty.

Currently, two monitoring sites (AURN site at Groeswen Hospital and Corus on site) are still operating to check the PM_{10} compliance with Air Quality Objectives. Further periodic monitoring work is continuing. More detailed analysis and assessment of pollution roses (including triangulation work) is being carried out to determine other significant PM_{10} contributors from the site. Corus, Neath Port Talbot council and the Environment Agency agree to work together on this issue.

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DISCLAMER

The opinions expressed in this paper are those of the authors and do not necessarily represent the views of the authors' affiliations.