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ScienceDirect
Atmospheric Environment 41 (2007) 6379–6395
ATMOSPHERIC ENVIRONMENT
www.elsevier.com/locate/atmosenv

An air quality survey and emissions inventory at Aberdeen Harbour

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Received 8 September 2006; received in revised form 12 April 2007; accepted 23 April 2007

Abstract

A network of 10 stations, with passive sampling for VOCs (including benzene), NO_2, and SO_2, over 2-week periods, grab sampling for CO, and 48-h pumped sampling for PM_{10}, was set up to make an air quality survey for 12 months around Aberdeen Harbour. Benzene, CO, SO_2 and PM_{10} were always well below the AQS target values. However, NO_2 frequently showed a pronounced gradient across the harbour reaching its highest concentrations at the city end, indicating that the road traffic was the principal source of the pollution. This was backed up by the predominance of aromatics in the VOCs in the city centre, derived from petrol engined vehicles, compared to the predominance of alkanes and alkenes around the docks, derived from diesel engined heavy trucks and possibly ships. Black carbon on the PM_{10} filters also showed a gradient with highest levels in the city centre. It is proposed that for such surveys in future, NO_2 and black carbon would be the two most informative parameters.

This emissions inventory has shown first, that trucks contribute very little to the total, and second, that the ro-ro ferries are the major contributors as they burn light fuel oil while the oil platform supply vessels burn low-sulphur marine gas oil with around 0.1% S. When the whole picture of the emissions from the city is considered, the emissions from the harbour constitute only a small part.
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Keywords: Harbours; Air quality; VOCs; NO_2; Emissions inventory

1. Introduction

The harbour at Aberdeen is noteworthy in that it reaches right into the city centre and therefore could be seen as a possible major contributor to the urban air pollution scenario. The City of Aberdeen, under its obligations imposed by the Environment Act 1995 and the Air Quality Regulations 1997, described in the UK National Air Quality Strategy of 1997 (The United Kingdom National Air Quality Strategy, 1997), began monitoring NO_2 using passive samplers, and PM_{10}, using a continuous TEOM monitor to give 1-h averages, in 1998. The outcome was that, while it was predicted that PM_{10} values (as annual averages) were unlikely to exceed the Air Quality Objective of $40\,\mu g\,m^{-3}$ annual mean at any of the sampling sites, NO_2 was likely to exceed the hourly mean Air Quality Objective of 105 ppb ($200\,\mu g\,m^{-3}$) on several occasions each year, especially in Market Street, which runs along

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1352-2310/$ - see front matter © 2007 Elsevier Ltd. All rights reserved.
doi:10.1016/j.atmosenv.2007.04.049

the inland end of the upper docks of Aberdeen Harbour. Because of this an Air Quality Management Area (AQMA) was declared, containing Market Street and adjacent streets, and a programme of further monitoring was begun. Fig. 1 shows a sketch map of the harbour in relation to the principal streets in the centre of Aberdeen.

A consideration of the map in Fig. 1 leads one quickly to the conclusion that it is not unreasonable that the city council should ask to what extent the activities in the harbour were contributing to the pollution levels in Market Street. It was decided to carry out a survey of the air quality around the harbour with the aim of assessing the air quality in relation to the UK NAQS Standards and the specific objective of answering the questions:

- How does the air quality around the harbour compare with that in the Aberdeen City AQMA ?
- Which pollutants, generated in the area of the harbour, are making a significant contribution to the air quality in the harbour? and
- Which pollutants should be selected for such monitoring for further investigation?

Aberdeen Harbour is the third largest port in Scotland, with over 8000 vessel arrivals in 2004, 4.7 million tonnes of cargo being handled, and 132,000 passengers passing through. The passengers are travelling on the two ro-ro ferries, of around 11,500 tonnes gross, which sail every evening for the Northern Isles. Cargo freighters bring timber, wood pulp, fuels, minerals and fertilisers, and leave with grain, scrap metal and paper. A number of fishing boats operate out of Aberdeen's fish market, but this is small compared to the size of the trawler fleet 50 years ago. However, the greater part of the cargo handled involves materials, supplies and equipment for the several hundred oil platforms operating in the North Sea, handled by a special class of cargo vessel, called supply boats of around 3000 tonnes gross, with large open rear decks to permit rapid loading and unloading. These are modern ships with powerful engines (because they may on occasion be called upon to tow platforms or to move sea anchors) burning a high-grade diesel-type fuel—marine gas oil, with less than 0.2% sulphur.

The objectives of the air quality survey were:

- To set up a network of ten sampling stations around the harbour.
- To collect analytical data for as many 2-week periods through the year as possible, in any event for periods representative of the main seasons of the year.
- To identify the most important pollutants and to measure their concentrations.
- To build an emissions inventory for the harbour area.

Since the shipping in the harbour was being looked on as a potential source of air pollutants, it was felt that an emissions inventory might help to back up the air quality measurements. On a

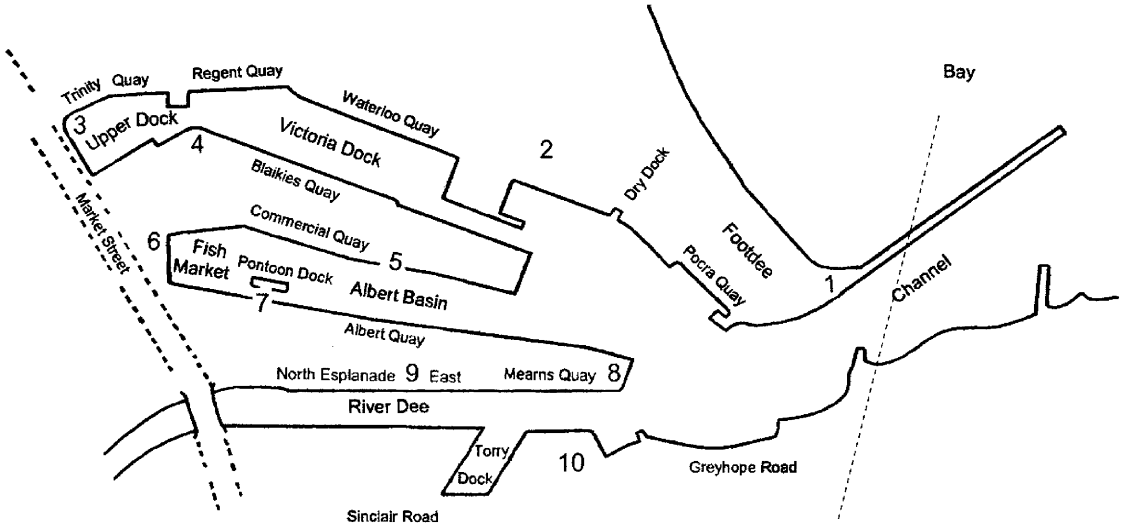

Fig. 1. Sampling sites around Aberdeen Harbour (numbers indicate sampling sites). Dashed line shows reference line from which distances to sampling sites are estimated.

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