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ENVIRONMENT AGENCY

Corus Integrated Steelworks, Scunthorpe
Source Characterisation of PM₁₀

DRAFT

November 2010

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November 2010

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1 INTRODUCTION

1.1.1 Wardell Armstrong LLP were instructed by Mr. Malcolm Beaver, of the Environment Agency, on 5th November 2009, to undertake source characterisation of PM₁₀, from five process areas within the Corus Integrated Steelworks, in Scunthorpe, in accordance with the tender document provided to Wardell Armstrong LLP on 23rd September 2009.

1.2 Tender Requirements

Task One – Process Sampling

1.2.1 The requirement for task one within the tender document was to obtain five viable ambient PM₁₀ air samples from the five process areas in the Steelworks. The process areas from which samples were to be taken were as follows:

- Coke Oven Roof
- Sinter Plant
- Blast Furnace Cast House
- BOS Plant
- Adjacent to the Slag Haul Road

Process Descriptions

Coke Ovens

1.2.2 Coal is the raw material used in the Coke Ovens and is converted in the Coke Ovens into its processed form – coke. The coal is crushed and ground into a powder and then charged into the ovens. Within the Coke Ovens the coal is heated, without oxygen, for approximately 18 hours to remove gases and impurities. The resultant coke is then used in the Blast Furnace.

Sinter Plant

1.2.3 Sintering is the process in which fine grain raw material is processed into coarse grained iron ore sinter for charging in the Blast Furnace.

Blast Furnace

- 1.2.4 Iron is extracted from its ores in the Blast Furnace. The Blast Furnace is a large steel cylinder lined with refractory bricks. The coke, iron ore and limestone enter the Blast Furnace from the top and pre-heated air is blown into the furnace from the bottom. The raw materials require 6 to 8 hours to descend to the bottom of the furnace where they become the final product of liquid slag and liquid iron.

Basic Oxygen Steel Making Process

- 1.2.5 Raw materials used in the Basic Oxygen Steelmaking (BOS) process are approximately 70-80% liquid hot metal from the Blast Furnace and the balance is steel scrap. The raw materials are charged into the Basic Oxygen Furnace (BOF) vessel which is a pear shaped furnace lined with refractory bricks. The raw materials enter the BOF from above and a lance is used to blow in a high pressure stream of oxygen. Molten steel is produced which can then undergo further refining or casting.

Slag Haul Road

- 1.2.6 Within the Steelworks site the slag haul road is a major route used by onsite vehicles to travel between process areas. The majority of vehicles using the haul road are large HGVs and onsite plant. The haul road is made of slag produced as a bi-product in the steel making process. During particularly dry conditions the slag can dry out and become dusty. The mechanical action of the wheels from the heavy duty vehicles on the slag haul road can result in dust from the road being suspended into the air and entrained causing a visible dust emission.

Task Two – Ambient Sampling

- 1.2.7 The requirement for task two within the tender document was to obtain filters from North Lincolnshire Council which represent periods of poor air quality at the two existing partisol monitoring stations. Five filters were to be obtained from the Santon partisol monitoring station and five from the Rowland Road monitoring station.

Task Three – Sample Analysis

1.2.8 Filters obtained from tasks one and two should be analysed with the objective of characterising the PM₁₀ samples by chemical and morphological means. Analysis should be undertaken using the following techniques:

- Iron Chromatography (IC)
- Inductively Coupled Plasma Mass Spectrometry (ICP-MS)
- Scanning Electron Microscopy - Energy Dispersive Spectroscopy (SEM/EDS)

1.3 Site Description

1.3.1 The Corus Steelworks is located on the eastern edge of Scunthorpe, North Lincolnshire and covers an area of approximately 11km². The Steelworks is located off the A1029 Brigg Road. The main land uses along the A1029 comprise existing industrial and commercial units. The closest residential areas lie to the west of the Steelworks off Rowland Road and to the north east off Station Road in High Santon. To the north and south of the Steelworks lie open fields and wooded areas.

1.4 Site Geology

1.4.1 The geology underlying an area can influence the composition of particulates in ambient air through windblown dust deposits. Therefore both the solid and superficial geologies in the Scunthorpe area have been considered.

Solid Geology

1.4.2 The site is underlain by an interbedded geology comprising mudstone, sandstone, siltstone and limestone from the Jurassic period. Mudstone and siltstone are generally comprised of clay minerals i.e. aluminium silicates and varying proportions of potassium (K), sodium (Na), calcium (Ca), magnesium (Mg) and iron (Fe). Sandstone is comprised of quartz (SiO₂) and cement material – usually feldspars, which are aluminium silicates with varying proportions of potassium, calcium, sodium and barium (Ba), these proportions are dependent on the type of feldspar.

1.4.3 Limestone is primarily composed of the minerals aragonite and calcite. Aragonite is composed of calcium carbonate (CaCO_3) and is not generally stable and quickly converted to calcite. Calcite is primarily formed by the neomorphism (recrystallisation process) of clay. There are two varieties of calcite. These are high-magnesium calcite and low-magnesium calcite. High-magnesium calcite contains more than 4% MgCO_3 and low-magnesium calcite contains less than 4% MgCO_3 .

1.4.4 Deposits of ironstone around the Scunthorpe area were extensively mined for use in the iron and steel process. These ironstone deposits are associated with the limestone deposits in the Jurassic rocks underlying Scunthorpe and their discovery resulted in the development of the iron and steel industry in the Scunthorpe area. The local ironstone reserves are now exhausted.

Superficial Geology

1.4.5 No significant drift deposits are recorded beneath the Corus Steelworks. However deposits of blown sand (which mainly comprises SiO_2) underlie the area surrounding the Steelworks. Further afield there are significant deposits of alluvium, glacial clay, glacial sand and gravel and clays from lake deposits. Alluvium is comprised of river deposits of clay, silt and sand. Glacial deposits can also contain fragments of rock from much wider areas.

1.5 Elemental Content of Soils

1.5.1 The samples taken will also contain elements that are not derived from the process areas, particularly for the Local Authority partisol samples which are monitoring ambient conditions as well as those Corus samples taken outside e.g. the Coke Oven roof samples and the Metal Recovery Plant and Slag Processing Area samples. These elements may be a result of natural sources or other anthropogenic sources. Table 1 shows the content of some of the major elements found in soils, the Earth's crust and sediments.

Table 1: Contents of some Elements in Soils, the Earth's Crust and Sediments				
Element	Soils (mg/kg)		Earth's Crust (mean)	Sediments (mean)
	Median	Range		
Oxygen	490,000	-	474,000	486,000
Silicon	330,000	250,000 - 410,000	277,000	245,000
Aluminium	71,000	10,000 - 300,000	82,000	72,000
Iron	40,000	2,000 - 550,000	41,000	41,000
Carbon	20,000	7,000 - 500,000	480	29,400
Calcium	15,000	700 - 500,000	41,000	66,000
Magnesium	5,000	400 - 9,000	23,000	14,000
Potassium	14,000	80 - 37,000	21,000	20,000
Sodium	5,000	150 - 25,000	23,000	5,700
Zinc	90	1 - 900	75	95

Source: Sparkes, D. 'Environmental Soil Chemistry', 2003.

1.5.2 Table 1 shows that oxygen and silicon are the most abundant elements in soil and the Earth's crust followed by aluminium and iron. Calcium, magnesium, potassium, sodium and zinc are all present in smaller proportions.

2 METHODOLOGY

2.1 Task One – Process Sampling

2.1.1 Sampling was undertaken by Wardell Armstrong LLP at the Corus Steelworks in Scunthorpe on Wednesday 27th January 2010, and over a three day period between Wednesday 3rd and Friday 5th March 2010.

2.1.2 The particulate samples were taken at five locations around the Corus site:

- The roof of the Dawes Lane Coke Ovens
- At a strand conveyor junction in the Sinter Plant
- In the enclosed cast house of the Blast Furnace
- The roof space of the BOS Plant
- In the enclosed cast house of the Blast Furnace
- Adjacent to the Slag Processing Area and Multiserv Metal Recovery Plant

2.1.3 It was not possible to take viable samples adjacent to the slag haul road as recent weather conditions had been extremely cold and wet and the slag haul road was saturated. This therefore meant that dust emissions resulting from HGV and onsite plant usage of the road were minimal. To obtain a sample representative of emissions from the slag haul road samples were taken at the Slag Processing Area and Metal Recovery Plant. Both of these process areas involve slag prior to its use to create the slag haul road. Therefore samples taken at the Slag Processing Area and Metal Recovery Plant were considered representative of emissions from the slag haul road. This methodology was agreed with Mr. John Dronfield, Regulatory Officer for the Environment Agency.

Sampling Pump and Equipment

2.1.4 The sampling was undertaken using two Leyland Legacy battery operated pumps, each with a PM₁₀ size selective inlet fitted to enable the collection of particles less than 10 microns in diameter. The size selective inlet was hand held and sampling was undertaken at a height of approximately 1.5m. The sampling equipment was not

static to allow samples to be taken where visible fume and dust emissions were occurring within the process areas.

2.1.5 During the initial sampling undertaken on Wednesday 27th January 2010 the sampling pumps were set to a flow rate of 5 L/min. However the initial sampling did not produce viable samples and the flow rate was therefore increased to 10 L/min for the sampling undertaken between 3rd - 5th March 2010. The sample pumps were calibrated, using a standard giliibrator, before and after each sample was taken. Each filter was exposed for 10 minutes. The filters were stored in sealed individual filter cases prior to sampling and returned to these cases once the sample had been taken.

2.1.6 Detailed notes were undertaken during the sampling which recorded the level of activity occurring at the process areas and general meteorological conditions where appropriate. These sampling notes are shown in Appendix A.

Filters

2.1.7 Pre-weighed GLA 47mm diameter filters, with a PVC membrane, were provided by TES Bretby for use in the size selective inlet attached to the Leyland Legacy sampling pumps. Three separate filters samples were obtained for each sample, each to be analysed by a different method; IC, ICP and SEM-EDS as required by the tender document.

2.1.8 Six blank samples were also obtained. These were field blanks and were transported to and from the Steelworks and to the process areas using the same method as the sample filters. The blank filters were not exposed and remained in their individual filter cases at all times. The blank filters were then gravimetrically weighed by the laboratory after the sampling had taken place to ensure no particulate contamination during transport to and from the site and during the sampling period.

2.2 Task Two – Ambient Sampling

2.2.1 Partisol filters for the Rowland Road and Santon continuous monitoring stations were provided to Wardell Armstrong LLP by North Lincolnshire Council. Ten filters were provided for each site, and were selected from periods of poor air quality where the daily air quality objective for PM₁₀ of 50µg/m³ was approached or exceeded.

2.2.2 The filters were analysed, by TES Bretby, using the same methods utilised for the process samples.

2.3 Task Three – Sample Analysis

2.3.1 Filters obtained from the process sampling, at the Corus Steelworks, and ambient sampling, by the North Lincolnshire Council partisol samplers, have been analysed using the three analysis techniques as required by the tender.

Ion Chromatography (IC)

2.3.2 IC has been used to determine concentrations of anions obtained from the process and ambient filter samples. The anions analysed using IC were:

- Chloride (Cl^-)
- Sulphate (SO_4^{2-})
- Nitrate (NO_3^-)

2.3.3 Sample analysis was undertaken by TES Bretby on behalf of Wardell Armstrong LLP. Samples were prepared in accordance with HS/Wi/1012 Issue 7 – Ion Chromatography Filter Methods. The filters were placed in polythene pots and ultrasonically extracted with deionised water. The resultant solutions were analysed by IC (Dionex IC20) using KOH eluent and an AS14 IonPac column in accordance with HS/Wi/1087 Issue 6 – The Determination of Anions using Dionex IC29 Ion Chromatography. All methods used are in-house UKAS accredited.

Inductively Coupled Plasma (ICP)

2.3.4 ICP-MS (inductively coupled plasma – mass spectrometry) and ICP-AES (inductively couple plasma – atomic emission spectrometry) have been used to provide concentrations of metals obtained from the process and ambient filter samples. The metals analysed using ICP-MS were:

- Arsenic (As)
- Cadmium (Cd)
- Chromium (Cr)
- Lead (Pb)
- Mercury (Hg)
- Nickel (Ni)

- Vanadium (V)

2.3.5 The metals analysed using ICP-AES were:

- Copper (Cu)
- Iron (Fe)
- Manganese (Mn)
- Phosphorous (P)
- Zinc (Zn)

2.3.6 Sample analysis was undertaken by TES Bretby on behalf of Wardell Armstrong LLP. Samples were prepared in accordance with HS/WI/1053 Issue 7 – Determination of Metals on Filters using a Microwave Method.. The filters were placed in PTFE vessels and digested with a mixture of high purity nitric and hydrofluoric acids using microwave assisted heating. The resultant solutions were complexed with boric acid and made to a known volume with deionised water. The solutions were analysed by ICP-MS/AES (Agilent 7500ce) in accordance with HS/WI/1002 Issue 19 – Operation and Maintenance of Inductively Coupled Plasma Mass Spectrometers (ICP-MS), and by ICP-AES (Perkin Elmer Optima 4300DV) in accordance with HS/WI/1075 Issue 8 – Operation and Maintenance of Perkin Elmer Optima 4300 Inductively Coupled Plasma Atomic Emission Spectrometer (ICP-AES). All methods used are in-house UKAS accredited. The preparation and analysis of filters by these methods complies with BSI EN 14385:2004 Stationary Source Emissions – Determination of the Total Emission of As, Cd, Cr, Co, Cu, Mn, Ni, Pb, Sb, Tl and V, British and European Standard.

Scanning Electron Microscopy - Energy Dispersive Spectrometry (SEM/EDS)

2.3.7 Using SEM-EDS it is possible to identify the nature of dust and to determine the chemical composition and size of nuisance and fugitive dusts. Chemical composition and physical appearance are important factors in differentiating the particles of dust. These are identified by systematically analysing 40 particles and the proportions of each are calculated to give an overall percentage of each category. A small section of the filter (approx. 1 cm²) is attached to an aluminium stub with a sticky tab, gold coated and analysed using the SEM/EDS equipment. Particles are identified by a combination of shape, appearance and EDS analysis. At least forty particles are analysed systematically, irrespective of size and shape. Usually only particles greater than 20 microns are examined, but where the particle size distribution does not include many particles greater than 20 microns (as in this

instance) the smaller particles are used in the determination. An initial scan of the sample is carried out to assess the homogeneity of the deposit. Individual particles are then selected for analysis. In order to avoid scanning the same area twice a systematic x, y scan is used. All particles analysed by SEM-EDS were less than 10 microns in diameters as required by the tender document.

3 ANALYSIS RESULTS AND ASSESSMENT

3.1 Ion Chromatography Analysis Results

- 3.1.1 The ion chromatography analysis, for the Corus Steelworks process area samples and the Local Authority partisol samples, has provided a mass of each analyte (chloride, sulphate and nitrate) present in the samples. The IC analyte mass results, including sampling notes, are shown in full in Appendix B. These mass results have been converted to a concentration of analyte present per sample using the volume of air which passed through each filter during the sampling period. The IC analyte concentrations are shown in Appendix C and Table 2.
- 3.1.2 An average analyte concentration and standard deviation have been calculated for each sample location. The results shown with an asterisk (*) represent those results below the limit of detection for the analyte. Where the analysis results are below the limit of detection the result has been taken as half the limit of detection to allow the calculation of an average.
- 3.1.3 Average concentrations of chloride, sulphate and nitrate at the five process areas are significantly higher than the average concentrations at the two partisol samplers. This is due to the process area samples been taken at the emission point whereas the partisol samplers represent ambient conditions.
- 3.1.4 Both the Santon and Rowland Road partisol analysis results, for each analyte, show reasonably low standard deviations from the average concentration despite the samples been taken over the period of a year. This suggests that ambient concentrations of chloride, sulphate and nitrate remain fairly consistent and are not overly influenced by specific emission sources.
- 3.1.5 Analyte concentrations from each process area show a high level of within area variability with much larger standard deviations being experienced. The analyte concentrations are greatly dependent on the level of activity within the process area as well as where the sample is taken within the process area.
- 3.1.6 No specific correlation is apparent between chloride, sulphate and nitrate concentrations at each of the process areas.

Table 2: IC Analysis Results for Corus and Local Authority Samples									
Station Name	Date Sample Taken	Filter ID	Analyte Concentration ($\mu\text{g}/\text{m}^3$)						
			Total Particulate	Chloride (Cl)	SD	Sulphate (SO_4)	SD	Nitrate (NO_3)	SD
Santon Partisol	14/01/09	750	n/a	1.23		4.21		5.78	
Santon Partisol	23/03/09	818	n/a	4.33		3.19		0.65	
Santon Partisol	07/05/09	863	n/a	3.04		3.33		1.17	
Santon Partisol	22/09/09	1000	n/a	1.70		3.59		0.85	
Santon Partisol	06/11/09	1046	n/a	3.48		3.48		5.48	
Average Santon Partisol Monitoring Station			n/a	2.75	1.28	3.56	0.40	2.78	2.60
Rowland Road Partisol	31/01/09	894	n/a	3.06		6.98		6.10	
Rowland Road Partisol	19/03/09	941	n/a	0.80		8.24		14.00	
Rowland Road Partisol	09/10/09	1145	n/a	2.91		3.48		2.89	
Rowland Road Partisol	06/11/09	1173	n/a	3.68		2.68		5.70	
Rowland Road Partisol	13/01/10	1241	n/a	0.40		7.70		7.63	
Average Rowland Road Partisol Monitoring Station			n/a	2.17	1.47	5.81	2.55	7.26	4.14
Coke Oven	03/03/10	1	470	21.90		5.80		7.80	
Coke Oven	03/03/10	4	950	35.50		6.70		8.10	
Coke Oven	03/03/10	9	1990	36.60		45.40		2.00*	
Coke Oven	03/03/10	76	950	19.10		4.70		2.00*	
Coke Oven	04/03/10	13	2340	40.50		15.10		2.00*	
Average Coke Oven			1340	30.72	9.56	15.54	17.19	4.38	3.26
Sinter Plant	04/03/10	16	2540	10.80		28.10		2.00*	
Sinter Plant	04/03/10	19	1340	4.10		2.60		2.00*	
Sinter Plant	04/03/10	24	4800	16.40		28.10		7.70	
Sinter Plant	04/03/10	25	2330	4.40		4.70		2.00*	
Sinter Plant	05/03/10	79	8900	9.30		44.50		2.00*	
Average Sinter Plant			3982	9.00	5.08	21.60	17.72	3.14	2.55
BOS Plant	04/03/10	31	5770	24.40		137.00		2.00*	
BOS Plant	04/03/10	34	2310	7.80		17.40		2.00*	
BOS Plant	04/03/10	37	1230	22.80		36.30		4.60	
BOS Plant	05/03/10	42	1100	14.50		25.10		7.40	
BOS Plant	05/03/10	43	2110	13.60		46.80		4.60	
Average BOS Plant			2504	16.62	6.89	52.52	48.52	4.12	2.25
Blast Furnace	03/03/10	61	930	10.40		5.90		2.00*	
Blast Furnace	03/03/10	64	1280	7.70		4.30		2.00*	
Blast Furnace	03/03/10	67	4280	12.40		6.60		2.00*	
Blast Furnace	03/03/10	70	5590	14.50		9.90		2.00*	
Blast Furnace	03/03/10	71	4070	19.30		605.00		2.00*	
Average Blast Furnace			3230	12.86	4.39	126.34	267.59	2.00	0.00
Metal Recovery Plant	03/03/10	46	1050	11.40		6.20		2.00*	
Metal Recovery Plant	05/03/10	49	560	10.00		4.40		7.20	
Metal Recovery Plant	05/03/10	52	510	352.00		33.60		30.40	
Metal Recovery Plant	05/03/10	55	620	8.60		3.40		7.30	
Slag Processing Area	05/03/10	39	1000	12.50		6.60		4.20	
Average MRP/SPA			748	78.90	152.67	10.84	12.79	10.22	11.50

* analyte mass below limit of detection

Background Chloride, Sulphate and Nitrate Concentrations

- 3.1.7 Background concentrations of chloride, sulphate and nitrate have been obtained from The Centre for Ecology and Hydrology (CEH) UK Pollutant Deposition Website¹ which is supported by Defra.
- 3.1.8 The background concentrations have been taken from the Caenby monitoring station, which is the closest available station to Scunthorpe, and forms part of the acid gases and aerosols monitoring network. 2008 backgrounds have been obtained which are the most recent backgrounds available. The Caenby monitoring station is rural in nature. No urban stations are available in the vicinity of the Steelworks.
- 3.1.9 The chloride, sulphate and nitrate background concentrations are shown in Table 3.

Table 3: 2008 Background Chloride, Sulphate and Nitrate Concentrations					
Site	Grid Reference	Approximate Distance from Steelworks	Average 2008 Chloride Concentration (µg/m³)	Average 2008 Sulphate Concentration (µg/m³)	Average 2008 Nitrate Concentration (µg/m³)
Caenby	SK993900	20km	0.96	0.90	2.28

- 3.1.10 The Santon and Rowland Road partisol average chloride, sulphate and nitrate concentrations are higher than the background concentrations from the Caenby monitoring station.

Chloride Concentrations

- 3.1.11 Consistent concentrations of chloride have been sampled at each process area. Standard deviations in chloride concentrations for the Coke Ovens, Sinter Plant, BOS Plant and Blast Furnace are less than 10.
- 3.1.12 A standard deviation of 152.67 is shown for the Metal Recovery Plant/Slag Processing Area samples. This high standard deviation is the result of the third

¹ <http://www.uk-pollutantdeposition.ceh.ac.uk/>

sample taken at the Metal Recovery Plant (filter 52 on 05/03/2010) which shows very high concentrations of chloride and is considered to be an outlier. Higher concentrations of sulphate and nitrate were also found in this sample. This sample was taken inside the enclosure leading to the hopper at the Metal Recovery Plant. Occasional tipping of scrap metal occurred during all samples taken at the Metal Recovery Plant. No unique activity or unusual sampling conditions occurred whilst this sample was being taken. It is therefore likely that the composition of the scrap is the determining factor in terms of analyte concentrations.

- 3.1.13 Whilst the Metal Recovery Plant/Slag Processing Area experiences the highest average chloride concentration this is skewed by the higher concentration from filter 52. Chloride concentrations are consistently higher at the Coke Ovens compared to the other four process areas. Coal is used extensively in the Coke Ovens and therefore the presence of chloride in the Coke Oven samples is explainable. The chloride content of coal varies from just a few parts per million to thousands of parts per million and it has been estimated that 94% of the chloride in coal is volatilized, generally being emitted as gaseous HCl^2 . This may explain why higher chloride emissions are found in the Coke Oven samples than the Blast Furnace sample.
- 3.1.14 Large amounts of recycled material, which may contain chlorine compounds, are used in the Sinter Plant³. In addition the Sinter Plant contains two strands both of which have a sinter hood firing Coke Oven gas which may contain both chloride and sulphate concentrations.
- 3.1.15 Chloride concentrations in the Santon and Rowland Road partisol samples are slightly higher than the background concentrations from the High Muffles and Moor House stations. This may indicate that emissions from the Steelworks may be influencing chloride concentrations at the partisol stations. However due to the within area variability in chloride concentrations it is not possible to determine which process area may have the greatest influence on chloride concentrations at the partisol samplers.

² Wei, X., Ewi-Lan, P., Shen, D., Wei-Ping, P. and Riley, J.T. ANL. Studies of Chlorine and Sulfur behaviour during coal combustion in an AFBC System.

³ Tsai, J.H., Lin, K.H., Chen, C.Y., Ding, J.Y., Choa, C.G. and Chiang, H.L. (2007) Chemical constituents in particulate emissions from an integrated iron and steel facility. *Journal of Hazardous Materials*, 147, 111-119.

Sulphate Concentrations

- 3.1.16 The IC results show more within area variability in sulphate concentrations and therefore standard deviations for each process area are higher for sulphate concentrations in comparison to chloride and nitrate standard deviations.
- 3.1.17 The highest sulphate concentration, of $605\mu\text{g}/\text{m}^3$, was found in the Blast Furnace on filter 71 taken on 03/03/2010. This sample was taken on the gantry above the tapping area where high sulphur levels were apparent. The other four Blast Furnace samples were taken at the lower level and sulphate concentrations for these samples are all below $10\mu\text{g}/\text{m}^3$. This indicates that fugitive emissions, which escape the air pollution control systems in the Blast Furnace, rise immediately following emissions and do not disperse to lower levels within the cast house.
- 3.1.18 The Coke Ovens and Blast Furnace experience sulphate concentrations ranging from 4.7 to $45.4\mu\text{g}/\text{m}^3$ and 17.4 to $137.0\mu\text{g}/\text{m}^3$ respectively. Sulphur is present in coal in varying amounts and as such sulphate concentrations would be expected from the Coke Oven, Blast Furnace and BOS Plant samples. The level of activity experienced during the sampling was variable within these three areas and this is reflected in the variability of sulphate concentrations within the process area samples.
- 3.1.19 The Sinter Plant also shows variable concentrations of sulphate. Sulphate concentrations over $28\mu\text{g}/\text{m}^3$ are found in three of the Sinter Plant filters. These may be attributed to sulphate concentrations present in the Coke Oven gas fired through the sinter hoods.
- 3.1.20 Concentrations of sulphate in the Santon and Rowland Road partisol samples are higher than background concentrations from the High Muffles and Moor House stations. Sulphate concentrations from Blast Furnace, Coke Oven and BOS Plant all show hot spot activity with one filter from each of these process areas showing significantly higher concentrations than the other four filters. In particular the Blast Furnace shows significant concentrations of sulphate in fugitive emissions during tapping. Fugitive emissions from the Blast Furnace, and to a lesser extent the Coke Ovens and BOS Plant, may be contributing to elevated concentrations of sulphate at the Santon and Rowland Road partisol

samplers.

Nitrate Concentrations

- 3.1.21 Concentrations of nitrate are generally lower than the comparative concentrations of chloride and sulphate within the process areas. Nitrate concentrations are also more consistent within the process areas and, as such, standard deviations are considerably lower than those associated with chloride and sulphate.
- 3.1.22 Nitrate concentrations on all five filters from the Blast Furnace are below the limit of detection of $0.4\mu\text{g}$. Three of the Coke Oven filters, four of the Sinter Plant filters, two of the BOS Plant filters and one of the Metal Recovery Plant filters also show nitrate concentrations below the limit of detection. Those filters from these process areas which do show nitrate concentrations above the limit of detection, show only very small concentrations apart from filter 52 taken at the Metal Recovery Plant as described in paragraph 3.1.6.
- 3.1.23 Nitrate concentrations in the Santon and Rowland Road partisol filters are higher than the background concentrations of nitrate found at the High Muffles and Moor House stations, in particular the Rowland Road partisol filters show an average nitrate concentration of $7.26\mu\text{g}/\text{m}^3$. Average nitrate concentrations at the process areas are all below $7.26\mu\text{g}/\text{m}^3$, apart from the Metal Recovery Plant whose average is skewed by filter 52 as explained in paragraph 3.1.21. It is therefore considered likely that the five process areas considered within the Corus Steelworks are not major contributors to nitrate emissions to air.

3.2 ICP Analysis

- 3.2.1 The ICP analysis, for the Corus Steelworks process area samples and the Local Authority partisol samples, has provided a mass of each analyte present in the samples. The ICP analyte mass results, including sampling notes, are shown in full in Appendix D. These mass results have been converted to a concentration of analyte present per sample using the volume of air which passed through each filter during the sampling period. The ICP analyte concentrations are shown in Appendix E and Table 3.

3.2.2 An average analyte concentration and standard deviation have been calculated for each sample location. The results shown with an asterisk (*) represent those results below the limit of detection for the analyte. Where the analysis results are below the limit of detection the result has been taken as half the limit of detection to allow the calculation of an average.

Table 3: ICP Analysis Results for Corus and Local Authority Samples														
Sample Location	Date Sample Taken	Filter ID	Analyte Concentration ($\mu\text{g}/\text{m}^3$)											
			As	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	P	V	Zn
Santon	14/01/09	750	0.013	0.001	0.123	0.013	10.50	0.100	0.700	0.004*	0.009	0.188	0.063	56.25
Santon	23/03/09	818	0.018	0.003	0.125	0.013	8.38	0.038	0.450	0.004*	0.013	0.300	0.068	60.00
Santon	07/05/09	863	0.021	0.003	0.188	0.025	8.88	0.075	0.375	0.004*	0.025	0.238	0.059	55.00
Santon	22/09/09	1000	0.015	0.001	0.124	0.013	8.25	0.063	0.288	0.004*	0.025	0.091	0.066	56.25
Santon	06/11/09	1046	0.021	0.005	0.120	0.038	6.00	0.288	0.238	0.004*	0.013	0.025	0.056	55.00
Average - Santon			0.02	0.003	0.14	0.02	8.40	0.11	0.41	0.004	0.02	0.17	0.062	56.50
Standard Deviation - Santon			0.004	0.002	0.03	0.01	1.61	0.10	0.18	0	0.01	0.11	0.005	2.05
Rowland Rd	31/01/09	894	0.015	0.001	0.119	0.013	7.63	0.063	0.238	0.004*	0.013	0.113	0.058	56.25
Rowland Rd	19/03/09	941	0.016	0.001	0.138	0.013	5.88	0.138	0.138	0.004*	0.025	0.088	0.059	61.25
Rowland Rd	09/10/09	1145	0.018	0.003	0.119	0.025	8.75	0.650	0.425	0.004*	0.013	0.075	0.055	55.00
Rowland Rd	06/11/09	1173	0.024	0.004	0.125	0.050	3.75	0.188	0.055	0.004*	0.013	0.003	0.051	56.25
Rowland Rd	13/01/10	1241	0.014	0.001	0.114	0.025	5.50	0.075	0.125	0.004*	0.013	0.138	0.058	51.25
Average - Rowland Road			0.02	0.002	0.12	0.03	6.30	0.22	0.20	0.004	0.02	0.08	0.056	56.00
Standard Deviation - Rowland Rd			0.004	0.001	0.01	0.02	1.94	0.24	0.14	0	0.01	0.05	0.003	3.58
Coke Oven	03/03/10	3	0.10	0.04*	2.30	0.20*	15.00	1.00	2.00	0.30*	7.00	2.50*	1.90	5.60
Coke Oven	03/03/10	8	0.20	0.04*	3.20	0.20*	6.70	0.35*	18.00	0.30*	9.10	2.50*	2.60	3.00
Coke Oven	03/03/10	6	0.20	0.04*	2.60	0.20*	4.60	0.35*	4.50	0.30*	3.00	2.50*	1.90	0.25*
Coke Oven	03/03/10	11	0.10	0.04*	2.50	2.00	7.20	0.90	2.10	0.30*	3.00	2.50*	2.70	0.25*
Coke Oven	04/03/10	14	0.06	0.04*	3.60	0.20*	14.00	0.80	3.30	0.30*	4.00	2.50*	2.60	0.25*
Average - Coke Oven Roof			0.13	0.04	2.84	0.56	9.50	0.68	5.98	0.30	5.22	2.50	2.34	1.87
Standard Deviation - Coke Oven Roof			0.06	0	0.54	0.80	4.68	0.31	6.80	0	2.72	0	0.40	2.40
Sinter Plant	04/03/10	17	0.10	0.04*	2.30	0.20*	120	1.00	2.30	0.30*	0.35*	2.50*	1.70	14.00
Sinter Plant	04/03/10	22	0.20	0.04*	3.30	0.20*	1200	3.00	19.00	0.30*	0.35*	2.50*	0.29	7.70

Sinter Plant	04/03/10	23	0.20	0.04*	3.20	0.90	610	4.00	13.00	0.30*	0.35*	2.50*	2.40	8.10
Sinter Plant	04/03/10	28	0.20	0.04*	3.40	0.70	960	5.00	18.00	0.30*	0.35*	2.50*	2.90	16.00
Sinter Plant	05/03/10	29	0.20	0.04*	3.90	2.00	760	4.00	15.00	0.30*	0.35*	2.50*	2.40	17.00
Average - Sinter Plant			0.18	0.04	3.22	0.80	730	3.40	13.46	0.30	0.35	2.50	1.94	12.56
Standard Deviation - Sinter Plant			0.04	0	0.58	0.74	406.57	1.52	6.68	0	0	0	1.02	4.39
BOS Plant	04/03/10	32	0.10	0.04*	2.70	1.00	1300	17.00	250.0	0.70	0.35*	2.50*	1.30	12.00
BOS Plant	04/03/10	35	0.09	0.04*	2.60	0.20*	250	4.00	14.00	0.30*	0.70	2.50*	0.83	4.00
BOS Plant	04/03/10	38	0.10	0.04*	2.40	0.20*	160	5.00	11.00	0.30*	0.35*	2.50*	1.20	0.25*
BOS Plant	05/03/10	60	0.20	0.04*	2.50	0.20*	420	37.00	15.00	0.30*	0.35*	2.50*	1.10	0.80
BOS Plant	05/03/10	59	0.20	0.04*	2.40	0.20*	160	39.00	41.00	0.30*	0.35*	2.50*	2.30	4.00
Average - BOS Plant			0.14	0.04	2.52	0.36	458.0	20.40	66.20	0.38	0.42	2.50	1.35	4.21
Standard Deviation - BOS Plant			0.06	0	0.13	0.36	482.51	16.88	103.45	0.18	0.16	0	0.56	4.69
Blast Furnace	03/03/10	62	0.20	0.04*	2.40	0.20*	78	0.35*	2.30	0.30*	6.00	2.50*	2.70	0.25*
Blast Furnace	03/03/10	65	0.20	0.04*	2.20	0.20*	40	0.80	5.40	0.30*	8.00	2.50*	1.60	0.25*
Blast Furnace	03/03/10	68	0.10	0.04*	2.70	1.00	700	3.00	15.00	0.30*	7.60	2.50*	3.00	8.60
Blast Furnace	03/03/10	72	0.20	0.04*	2.60	0.20*	1100	2.00	34.00	0.30*	8.50	2.50*	2.40	20.00
Blast Furnace	03/03/10	73	1.10	0.04*	4.90	3.00	5600	7.00	39.00	0.30*	14.00	2.50*	7.60	16.00
Average - Blast Furnace Cast House			0.36	0.04	2.96	0.92	1503.6	2.63	19.14	0.30	8.82	2.50	3.46	9.02
Standard Deviation - Blast Furnace			0.42	0	1.10	1.21	2332.6	2.65	16.62	0	3.04	0	2.37	8.99
MRP	03/03/10	47	0.20	0.04*	2.30	0.20*	10.00	0.35*	5.20	0.30*	3.00	2.50*	2.20	0.25*
MRP	05/03/10	50	0.20	0.04*	3.20	0.20*	21.00	5.00	5.00	0.30*	0.35*	2.50*	2.40	2.00
MRP	05/03/10	53	0.20	0.04*	2.50	0.20*	40.00	0.35*	5.50	0.30*	0.35*	2.50*	1.50	0.25*
MRP	05/03/10	56	0.30	0.04*	2.00	0.20*	16.00	0.35*	2.10	0.30*	0.35*	2.50*	2.40	0.25*
SPA	05/03/10	40	0.20	0.10	3.10	0.20*	5.30	1.00	0.60	0.30*	0.35*	6.00	2.40	0.25*
Average MRP/SPA			0.22	0.05	2.62	0.20	18.46	1.41	3.68	0.30	0.88	3.20	2.18	0.60
Standard Deviation - MRP/SPA			0.04	0.03	0.52	0	13.43	2.03	2.20	0	1.19	1.57	0.39	0.78

* analyte mass below limit of detection

Background Heavy Metal Concentrations

3.2.3 Background concentrations of the metals considered in the ICP analysis have been obtained for the Scunthorpe Low Santon and Scunthorpe Town monitoring stations. These stations form part of the UK Heavy Metals Monitoring Network. The 2009 heavy metal background concentrations are shown in Table 4. These have been obtained from the UK Heavy Metals Monitoring Network 2009 Annual Report.⁴

Table 4: 2008 Background Chloride, Sulphate and Nitrate Concentrations		
Metal	Scunthorpe Low Santon 2009 Average Concentration (µg/m³)	Scunthorpe Town 2009 Average Concentration (µg/m³)
As	0.0009	0.0008
Cd	0.0002	0.0002
Cr	0.0041	0.0022
Cu	0.0056	0.0061
Fe	1.85	0.49
Mn	0.11	0.0217
Ni	0.0013	0.0008
Pb	0.0341	0.0161
V	0.0050	0.0018
Zn	0.0321	0.0231
Hg (p)	0.00002	0.00002

3.2.4 Metal concentrations in the process area samples and ambient samples are all significantly higher than the background concentrations shown in Table 4.

Ambient and Process Area Heavy Metal Concentrations

3.2.5 The Santon and Rowland Road partisol analysis results show mainly low concentrations of the considered metals in the samples. However concentrations of zinc and iron are comparably high.

3.2.6 Metals concentrations from the five process areas show high levels of within area variability with much larger standard deviations being experienced compared to the partisol samplers. The analyte concentrations are greatly

⁴ NPL Report AS 49, Report to the Department of Environment, Food and Rural Affairs, and the Devolved Administrations, by the National Physical Laboratory, Annual Report for 2009 on the UK Heavy Metals Monitoring Network, March 2010.

dependent on the level of activity occurring within the process area as well as where the sample is taken within the process area.

- 3.2.7 Average concentrations of all the metals considered by ICP analysis are significantly higher at the process areas than average concentrations at the two partisol samplers. This is due to the process area samples been taken at the emission point whereas the partisol samplers represent ambient conditions. The exception to this is zinc concentrations which are significantly higher at the partisol samplers than at the five process areas. The average zinc concentrations from the Santon and Rowland Road filters are $56.5\mu\text{g}/\text{m}^3$ and $56\mu\text{g}/\text{m}^3$ respectively. These concentrations exceed the daily PM_{10} air quality objective of $50\mu\text{g}/\text{m}^3$ for zinc alone without the consideration of the other metals and elements included in the analysis. This may indicate that the main cause of elevated particulate concentrations at the Santon and Rowland Road partisol samplers are high concentrations of zinc, however it is considered likely that the high zinc concentrations are possibly a result of contamination.
- 3.2.8 Standard deviations for the Santon and Rowland Road partisol samplers, for all the analytes considered in the ICP analysis, are reasonably low. Standard deviations in zinc concentrations are higher for both partisol samplers than the other analytes considered. This suggests that ambient concentrations of all analytes except zinc are fairly consistent and are possibly not overly influenced by specific emission sources.
- 3.2.9 Zinc concentrations in the partisol samples are significantly higher than those found in samples from the process areas. Standard deviations in zinc concentrations at the partisol samplers are also higher than those for the other metals considered by ICP analysis. If the high zinc concentrations found on the partisol samples are not a result of contamination, the high standard deviations suggest that whilst the process areas may be contributing slightly to ambient zinc concentrations it is likely that another emission source is also contributing to elevated zinc concentrations at the partisol locations. This source may be another area within the Steelworks which has not been considered in this project or another point source from a different installation.
- 3.2.10 Iron concentrations from the process area filters are the highest of the analytes considered by the ICP analysis. Average iron concentrations are highest from

the Blast Furnace ($1506.6\mu\text{g}/\text{m}^3$), the BOS Plant ($458\mu\text{g}/\text{m}^3$) and the Sinter Plant ($730\mu\text{g}/\text{m}^3$). Average concentrations of iron found on the Coke Oven and Metal Recovery Plant/Slag Processing Area filters are considerably lower. Iron is one of the most abundant metals found in soils and therefore higher concentrations of iron in ambient samples would be expected. However iron concentrations at the partisol locations are higher than the background concentrations shown in Table 4.

3.2.11 Fugitive emissions of iron from the Sinter Plant, BOS Plant and Blast Furnace could possibly be contributing to higher iron concentrations at the partisol samplers. However as three of the five locations considered do show high iron concentrations it is unlikely that iron can be used to identify one specific process area contributing to elevated PM_{10} concentrations at the two partisol samplers.

3.2.12 Manganese and iron concentrations on the Sinter Plant filters do show a positive correlation. The BOS Plant and Blast Furnace filters also show a positive correlation in iron and manganese concentrations to a lesser extent than the Sinter Plant. A small positive correlation is also shown between iron and manganese concentrations on the Santon and Rowland Road partisol filters. However as the Sinter Plant, Blast Furnace and BOS Plant all show high concentrations of iron and a correlation between iron and manganese concentrations it would not be possible to determine which process area is contributing to elevated concentrations of either element at the partisol locations.

3.2.13 Average lead concentrations from the BOS Plant are the highest of the five process areas at $20.4\mu\text{g}/\text{m}^3$. Average lead concentrations found on the filters from the other four process areas are all below $3.4\mu\text{g}/\text{m}^3$. It is therefore considered possible that lead concentrations could be a trace for emissions from the BOS Plant. The average lead concentrations found on filters analysed from the Santon and Rowland Road partisol samplers are $0.11\mu\text{g}/\text{m}^3$ and $0.22\mu\text{g}/\text{m}^3$. The annual air quality objective for lead is $0.25\mu\text{g}/\text{m}^3$. Whilst five filters from each Partisol sampler are not enough to determine the average annual concentration of lead it is possible that the annual objective for lead could be approached at Partisol sampler 2 when background concentrations are considered.

3.2.14 Average nickel concentrations from the Blast Furnace are the highest of the five process areas at $8.82\mu\text{g}/\text{m}^3$. The Coke Oven filters show an average nickel concentration of $5.22\mu\text{g}/\text{m}^3$. The other three process areas all show average nickel concentrations below $0.88\mu\text{g}/\text{m}^3$. It may therefore be possible to use nickel as a trace metal for fugitive emissions from the Blast Furnace.

3.3 SEM/EDS Analysis Results

3.3.1 Ten filters from each partisol sampler have been analysed using SEM/EDS and each filter was analysed five times. The average results for each filter are shown in Tables 5 and 6 for the Santon partisol sampler and Rowland Road partisol sampler respectively. Full SEM/EDS results, detailing the results from each of the five sections analysed per filter are shown in Appendix F.

Local Authority Santon Partisol Sampler

Date Sample Taken	Filter ID	CM (%)	Animal /Plant (%)	Ca Rich (%)	Fe Rich (%)	Si Rich (%)	Al/Si Rich (%)	Ca/Mg Rich (%)	Ca/S Rich (%)	Ca/Si Rich (%)	Na/Cl Rich (%)	Al/Ca/Si Rich (%)	Al/K/Si Rich (%)	Pb/Cl Rich (%)	Mg/S Rich (%)	Other (%)
14/01/09	750	7	1	42	12	4	1	20	7	3	0	5	0	0	0	0
21/03/09	816	5	2	2	6	25	7	0	8	1	0	18	26	0	0	0
23/03/09	818	19	0	1	3	12	16	1	5	3	1	30	8	0	0	0
07/05/09	863	30	0	18	9	1	5	12	3	10	10	1	1	0	1	1
08/05/09	864	14	3	7	9	16	3	0	0	18	4	22	4	0	0	0
20/08/09	968	24	3	21	8	13	1	0	0	15	0	13	2	0	0	0
21/09/09	999	19	0	23	10	13	2	0	0	16	2	13	2	0	0	0
22/09/09	1000	35	2	14	4	10	1	2	7	9	2	12	2	0	0	0
06/11/09	1046	37	1	2	7	12	2	0	18	0	9	7	3	2	0	2
18/02/10	1151	4	9	2	6	38	4	0	9	7	0	8	13	0	0	0

3.3.2 The SEM/EDS average analysis results for the Santon partisol sampler show that carbonaceous matter, calcium, iron and silicon form the majority of particulate deposited on the filters. A combination of elements such as calcium/silicon and aluminium/calcium/silicon also represent a significant proportion of the particulate analysed.

Local Authority Rowland Road Partisol Sampler

Date Sample Taken	Filter ID	CM (%)	Animal /Plant (%)	Ca Rich (%)	Fe Rich (%)	Na Rich (%)	Si Rich (%)	Al/ Si Rich (%)	Ca/ Mg Rich (%)	Ca/S Rich (%)	Ca/ Si Rich (%)	Na/ Cl Rich (%)	Mg/ S Rich (%)	Mg/ Si Rich (%)	Al/ Ca/ Si Rich (%)	Al/K /Si Rich (%)	Other (%)
01/01/09	864	8	6	0	0	0	32	4	0	19	0	0	0	0	4	27	0
30/01/09	893	8	3	0	5	0	18	0	0	20	4	0	0	0	17	25	0
31/01/09	894	32	1	0	19	0	9	4	1	11	0	1	12	1	8	2	2
18/03/09	940	1	1	3	2	0	16	4	0	32	0	0	0	0	13	27	0
19/03/09	941	18	0	0	16	1	2	1	1	42	0	0	5	0	1	6	7
09/10/09	1145	25	1	13	20	5	10	2	7	7	0	4	0	1	6	1	1
06/11/09	1173	25	2	1	4	0	36	3	0	13	1	1	0	4	0	7	2
13/01/10	1241	44	3	1	7	0	16	2	0	14	0	0	7	0	0	5	0
14/01/10	1242	6	3	1	3	0	44	3	0	21	0	0	0	0	2	16	0
19/02/10	1278	12	3	2	4	0	28	3	0	5	4	0	0	0	14	23	0

3.3.3 The SEM/EDS average analysis results for the Rowland Road partisol sampler show that carbonaceous matter, iron and silicon form the majority of particulate deposited on the filters. A combination of elements such as calcium/sulphur and aluminium/potassium and silicon also represent a significant proportion of the particulate analysed.

Coke Oven Roof

3.3.4 For the purposes of the report those species which comprise less than 1%, of the 40 particles analysed per filter using SEM/EDS, have been recorded as other. The full SEM/EDS results are detailed in Appendix F.

Date Sample Taken	Filter ID	CM (%)	Ca Rich (%)	Animal/ Plant (%)	Fe Rich (%)	Na Rich (%)	Al Rich (%)	Al/Si Rich (%)	Al/Ca/Fe /Si Rich (%)	Al/Ca/Na /Si Rich (%)	Other (%)
03/03/10	05	88	0	10	0	0	0	0	0	0	2
03/03/10	07	40	23	8	5	5	2	5	5	5	2
03/03/10	10	58	23	0	8	2	5	0	0	0	4
04/03/10	12	45	23	5	8	8	0	0	0	0	9
04/03/10	15	100	0	0	0	0	0	0	0	0	0
Average		66.2	13.8	4.6	4.2	3	1.4	1	1	1	3.4

3.3.5 The SEM/EDS analysis results for the five filters sampled at the Coke Ovens show that carbonaceous matter forms the majority of particulate deposited on the filters. Calcium deposits are also significant on three of the filters taken. Trace elements also include animal and plant fragments, iron and sodium.

3.3.6 The presence of trace amounts of sodium were also found on three of the Coke Oven filters. The SEM/EDS analysis did not show sodium particles on filters from the other four process areas. The presence of sodium could therefore be used as a trace for fugitive emissions from the Coke Ovens.

Sinter Plant

Table 5: SEM/EDS Analysis Results for Sinter Plant Samples													
Date Sample Taken	Filter ID	CM (%)	Fe Rich (%)	Ca Rich (%)	Ca/Fe Rich (%)	Animal /Plant (%)	Al/Ca/ Fe/Si Rich (%)	Ca/Si/ Rich (%)	Ca/Fe/ Si/Rich (%)	Ca/Fe/ Mg/Si Rich (%)	Si Rich (%)	Al Rich (%)	Other (%)
04/03/10	20	85	2	0	3	10	0	0	0	0	0	0	0
04/03/10	21	40	25	20	0	8	0	0	0	0	5	2	0
04/03/10	26	97	3	0	0	0	0	0	0	0	0	0	0
04/03/10	27	18	20	13	20	0	8	10	0	2	0	2	7
04/03/10	30	18	13	18	18	2	10	2	8	5	0	0	6
Average		51.6	12.6	10.2	8.2	4.0	3.6	2.4	1.6	1.4	1.0	0.8	2.6

3.3.7 The SEM/EDS analysis results for the five filters sampled at the Sinter Plant show that carbonaceous matter forms the majority of particulate deposited on the filters. On two of the filters the carbonaceous matter content is almost 100% and therefore few trace elements are found. On the remaining three filters where carbonaceous matter content is lower traces of iron, calcium and a combination of iron and calcium are found.

Blast Furnace Cast House

Table 6: SEM/EDS Analysis Results for Blast Furnace Cast House Samples							
Date Sample Taken	Filter ID	CM (%)	Animal/ Plant (%)	Al/Si Rich (%)	Si Rich (%)	Fe Rich (%)	Other (%)
03/03/10	63	90	0	5	2	0	3
03/03/10	66	85	5	3	0	5	2
03/03/10	69	95	2	0	0	0	3
03/03/10	74	97	0	0	3	0	0
03/03/10	75	95	2	0	0	0	3
Average		92.4	1.8	1.6	1.0	1.0	2.2

3.3.8 The SEM/EDS analysis results for the five filters sampled at the Blast Furnace cast house show that carbonaceous matter content is at least 85% on all five filters with an average of 92.4%. Trace element content is therefore much lower in the Blast Furnace samples than for the other four process areas.

BOS Plant Roof Space

Table 7: SEM/EDS Analysis Results for BOS Plant Roof Space Samples																
Date Sample Taken	Filter ID	CM (%)	Ca Rich (%)	Ca/ Mg Rich (%)	Fe Rich (%)	Al/ Ca/ Mg/ Si Rich (%)	Animal / Plant (%)	Al/Si Rich (%)	Si Rich (%)	Al Rich (%)	Al/C a/Si Rich (%)	Ca/S Rich (%)	Ca/ Si Rich (%)	Al/K /Si Rich (%)	Ca/ Na/ Mg/ Si Rich (%)	Other (%)
04/03/10	33	63	0	13	2	0	5	0	8	5	0	0	0	0	0	4
04/03/10	36	58	13	8	0	0	5	0	0	5	3	0	0	2	0	6
04/03/10	44	18	8	15	13	10	0	10	2	0	0	8	5	0	5	6
05/03/10	45	20	20	8	10	15	8	2	0	0	8	0	0	5	0	4
05/03/10	58	63	3	0	18	0	0	5	3	2	0	0	2	0	0	4
Average		44.4	8.8	8.8	8.6	5.0	3.6	3.4	2.6	2.4	2.2	1.6	1.4	1.4	1.0	4.8

3.3.9 The SEM/EDS analysis results for the five filters sampled at the BOS Plant show the presence of the greatest number of elements compared with the other four process areas. Carbonaceous matter again forms the majority of particulate found on the filters. Significant trace elements include calcium and iron and a combination of calcium/magnesium and aluminium/calcium/magnesium/silicon.

3.3.10 The largest traces of calcium/magnesium were found on the BOS Plant filters. Calcium/magnesium was not found on the Coke Oven, Sinter Plant, Blast Furnace or Metal Recovery Plant filters. A very small trace (2%) of Ca/Mg was found on the Slag Processing Area filter. The presence of calcium/magnesium could therefore be used as a trace for fugitive emissions from the BOS Plant roof space.

Metal Recovery Plant and Slag Processing Area

Table 8: SEM/EDS Analysis Results for Metal Recovery Plant/Slag Processing Area Samples									
Process Area	Date Sample Taken	Filter ID	CM (%)	Ca Rich (%)	Animal/ Plant Fragments (%)	Ca/Si Rich (%)	Fe Rich (%)	Ca/Mg Rich (%)	Al/Fe/K/ Si Rich (%)
Metal Recovery Plant	03/03/10	48	97	3	0	0	0	0	0
Metal Recovery Plant	05/03/10	51	95	2	0	0	3	0	0
Metal Recovery Plant	05/03/10	54	93	0	5	0	0	0	2
Metal Recovery Plant	05/03/10	57	98	0	2	0	0	0	0
Slag Processing Area	05/03/10	41	50	18	10	15	5	2	0
Average			86.6	4.6	3.4	3	1.6	0.4	0.4

3.3.11 The SEM/EDS analysis results for the five filters sampled at the Metal Recovery Plant/Slag Processing Area show that carbonaceous matter forms the majority of particulate found on the filters. Very few trace elements are detected on the Metal Recovery Plant filters but the Slag Processing Area filter does show significant traces of calcium and a combination of calcium and silicon.

3.4 SEM Photomicrographs

- 3.4.1 SEM photomicrographs have been provided by the laboratory undertaking the filter analysis. All SEM/EDS analysis results and SEM photomicrographs are included in Appendix G. The SEM photomicrographs do not differentiate between colours. Bright spots on the SEM photomicrographs relate to particles with a higher atomic number.
- 3.4.2 The photomicrographs obtained from the process area filters do show variability between the process areas and within the process areas. The photomicrographs are affected by the location the samples were taken as well as the amount of material that was deposited on the filter.
- 3.4.3 The SEM/EDS analysis results and the photomicrographs for the Corus filters show an elemental composition often comprising carbonaceous matter, iron, calcium and animal and plant fragments with trace elements including aluminium, sulphur, magnesium, silicon and sodium. The morphology detailed on the photomicrographs shows agglomerations of similar, mostly spherical particles with occasional angular or larger more individual spherical particles.
- 3.4.4 The samples taken within the Corus process areas used PVC membrane filters. The Local Authority filter samples were taken onto PTFE filters. The difference in filter materials is shown in the SEM photomicrographs. However it is still possible to compare and contrast particulate deposits collected on both types of filter.

Coke Oven Roof

- 3.4.5 At least 99% of particles analysed from the Coke Oven filters were less than 10µm in size. The results of the SEM/EDS analysis have shown that the majority of particles analysed from the five sample filters are carbonaceous matter. Animal and plant fragments and calcium also comprise significant particulate deposits.
- 3.4.6 Significant agglomerations of similar spherical particles are shown on filters 00983/05 and 00983/15. These are the two Coke Oven filters which comprise the highest percentage of carbonaceous matter (88% and 100% respectively).

- 3.4.7 No particularly large particles are visible in any of the five photomicrographs from the coke oven samples and the particles shown do not appear to be angular in nature.

Sinter Plant

- 3.4.8 Of all particles analysed from the Sinter Plant filters, at least 99% were shown to be less than 10µm in size. The results of the SEM/EDS analysis have shown that significant deposits of carbonaceous matter, iron, calcium and animal and plant fragments were found on the sinter plant filters with traces of elements including silicon, aluminium, magnesium and potassium.
- 3.4.9 Significant agglomerations of similar spherical particles are again shown on those filters comprising a high percentage of carbonaceous matter (filters 00983/20 and 00983/26). Occasional larger, angular particles are also shown on filters 00983/20, 00983/27 and 00983/30 which may be associated with the iron ore used in the Sinter Plant.

Blast Furnace Cast House

- 3.4.10 99% of particles analysed from the Blast Furnace cast house filters were less than 10µm in size. All filters show a carbonaceous matter content of above 85% and agglomerations of similar spherical particles are present on all five filters.
- 3.4.11 Filter 00983/74 shows a large particulate mass of 3548µg. This filter was taken next to an open window of the chamber in which molten iron was being poured into the transportation torpedo. The photomicrograph of this filter shows a heavily deposited filter with obvious agglomerations of similar spherical particles. The presence of slightly larger spherical particles is also apparent. No angular particles are shown on the photomicrographs.

BOS Plant

- 3.4.12 At least 99% of particles analysed from the BOS Plant filters are less than 10µm in size. No angular particles are shown on the photomicrographs.
- 3.4.13 Agglomerations of spherical particles are shown on filters 00983/33, 00983/36 and 00983/58. These three filters show a carbonaceous matter content of more

than 58%. Agglomerations of much smaller spherical particles are shown on filter 00983/44.

Metal Recovery Plant/Slag Processing Area

- 3.4.14 The SEM photomicrographs from the four Metal Recovery Plant filters are all similar and show agglomerations of spherical particles as per the filters mentioned previously from the Coke Oven, Sinter Plant, Blast Furnace and BOS Plant samples. At least 99% of particles analysed were less than 10µm in size. No angular particles are present on the SEM photomicrographs.
- 3.4.15 Only one filter was taken from the Slag Processing Area. This looks significantly different to the Metal Recovery Plant Filter and does not show the same agglomerations of spherical particles.

Local Authority Partisol Monitoring Stations

- 3.4.16 The Santon and Rowland Road SEM photomicrographs show a range of different sized particles. The SEM/EDS analysis for each partisol filter shows the particulate deposit is comprised of a range of particles some of which will be naturally occurring such as silica (from soils) and sodium chloride (sea salt). These naturally occurring particles are likely to be larger than anthropogenic particles which may be apportioned to the Corus Steelworks or other industrial processes in the area.
- 3.4.17 Both the Santon and Rowland Road SEM photomicrographs show a combination of angular, spherical and agglomerated particles on each filter. At least 99% of all particles analysed on the Santon and Rowland Road filters were less than 10µm in size.

4 DEVELOPMENT OF A FINGERPRINT FOR EACH PROCESS AREA AND COMPARISON WITH THE LOCAL AUTHORITY PARTISOL SAMPLERS

Coke Ovens

- 4.1.1 Particles containing sodium were only found on filters from the Coke Ovens. The SEM/EDS analysis did not show sodium particles on filters from the other four process areas. It is therefore considered that sodium is a trace element of emissions from the Coke Ovens.
- 4.1.2 No sodium particles were found on filters from Santon partisol sampler which is located closer to the Coke Ovens than the other four process areas. However it was only possible to analyse ten filters from the partisol samplers, using SEM/EDS, as part of this study. A longer term study would need to be conducted to ensure that emissions from the Coke Ovens were not causing the elevated particulate concentrations being detected by the Santon partisol sampler.
- 4.1.3 Sodium particles were found on two filters from the Rowland Road partisol sampler. No sodium particles were detected on the other eight filters analysed by SEM/EDS from the Rowland Road partisol sampler. As sodium particles were only found on two of the filters from the Rowland Road partisol sampler it is unlikely that sodium particles are naturally found in the locality of the Rowland Road partisol sampler and therefore are more likely to be resulting from point source emissions.
- 4.1.4 A longer term study would need to be conducted to attribute sodium particles from the Steelworks Coke Ovens to elevated particulate concentrations being detected at the Rowland Road partisol sampler. Meteorological data would also be required to consider the effect of wind direction as the Rowland Road partisol sampler is located approximately 1700m to the west (upwind) of the Coke Ovens.

Sinter Plant

- 4.1.5 The ICP analysis showed the Sinter Plant filters contained high average concentrations of iron ($730\mu\text{g}/\text{m}^3$) and the SEM/EDS analysis also showed the presence of iron in the particles considered. However high average

concentrations of iron were also found on the Blast Furnace and BOS Plant filters and it is not considered possible therefore to use iron as a trace element for fugitive emissions from the Sinter Plant.

4.1.6 The SEM photomicrographs of the Sinter Plant filters have shown the presence of occasional angular particles within the particulate deposit. No obvious angular particles were found on the photomicrographs from the other process areas.

4.1.7 Filters from the Sinter Plant also showed the highest zinc concentrations, of the five process areas, with an average of $12.56\mu\text{g}/\text{m}^3$. However the presence of zinc was also found in filter samples from the Coke Ovens, BOS Plant and the Blast Furnace. Due to the presence of zinc in samples from these process areas it is not considered possible to use zinc as a trace element for fugitive emissions from the Sinter Plant.

4.1.8 High average concentrations ($>56\mu\text{g}/\text{m}^3$) of zinc were found on the filters from both partisol samplers. These are considerably higher than the process area zinc concentrations. If the process areas considered were causing elevated zinc concentrations at the partisol samplers dilution effects would mean that the concentrations of zinc on the partisol filters would be less than those from the process areas. It is however possible that the high zinc concentrations found on the partisol filters are a result of contamination.

4.1.9 Background concentrations of zinc for the Scunthorpe Low Santon and Scunthorpe Town heavy metal monitoring stations have been obtained from the 2009 Annual Report on the UK Heavy Metals Monitoring Network.⁵ The zinc backgrounds for 2009 are $0.03\mu\text{g}/\text{m}^3$ and $0.02\mu\text{g}/\text{m}^3$ respectively. High concentrations of zinc therefore do not occur naturally in this area.

4.1.10 Whilst emissions of zinc from the Sinter Plant may be a small contributor to zinc concentrations at the Partisol samplers it is not possible to apportion emissions from the Sinter Plant, or any of the other four process areas, as the probable origin of zinc concentrations found at the Partisol samplers.

⁵ NPL Report AS 49, Report to the Department of Environment, Food and Rural Affairs, and the Devolved Administrations, by the National Physical Laboratory, Annual Report for 2009 on the UK Heavy Metals Monitoring Network, March 2010.

Blast Furnace Cast House

- 4.1.11 Filters from the Blast Furnace have the highest average sulphate concentrations ($126.34\mu\text{g}/\text{m}^3$) of the five process areas. However these results are skewed by the high sulphate concentration from filter 71 of $605\mu\text{g}/\text{m}^3$ which was taken on the gantry above the tapping area. The ICP analysis results show that the highest iron concentrations were found on the Blast Furnace filters with an average iron concentration of $1503.6\mu\text{g}/\text{m}^3$. This average is also skewed by the iron concentration of $4600\mu\text{g}/\text{m}^3$ found on filter 73 which was also taken on the gantry above the tapping area at the same time as filter 71. It is possible that further samples taken at this location in the cast house may provide a much higher average sulphate and iron concentration which is significantly different to the other four process areas. Further spot samples would need to be carried out to verify this possibility, however, it is considered likely that sulphate concentrations could be used as a trace for emissions from the Blast Furnace.
- 4.1.12 The ICP analysis provides a high average iron concentration of $1503.6\mu\text{g}/\text{m}^3$ from the Blast Furnace filters however the SEM/EDS analysis only identifies the presence of iron on one filter at 5% richness. This may be due to only 40 particles being considered by each SEM/EDS analysis which may not be representative of the whole filter. Results should therefore be treated with caution.
- 4.1.13 Average nickel concentrations from the Blast Furnace are higher than the other four process areas at $8.82\mu\text{g}/\text{m}^3$. It is therefore likely that nickel could be used as a trace element for emissions from the Blast Furnace. Average nickel concentrations at the two Partisol samplers are very low at $0.02\mu\text{g}/\text{m}^3$ for both samplers with standard deviations of $0.01\mu\text{g}/\text{m}^3$ for both Partisol samplers. Dilution of fugitive emissions from the process areas will occur due to wind and building effects which create turbulent air flow. Therefore even if the pollutant concentration at the Partisol samplers is low in comparison to the process areas this does not mean that the process area is not contributing to particulate mass on the Partisol filters. The low standard deviations in nickel concentrations from both Partisol samplers suggests however that nickel concentrations are reasonably consistent and may not be overly influenced by an existing point source. This indicates that the Blast Furnace may not be the cause of elevated

particulate concentrations at the Partisol samplers. However this would need to be verified by further monitoring.

BOS Plant Roof Space

4.1.14 The average concentration of lead found on filters from the BOS Plant is $0.4\mu\text{g}/\text{m}^3$. This is considerably higher than the other four process areas all of which all have average lead concentrations of less than $3.4\mu\text{g}/\text{m}^3$. It is therefore considered possible that lead concentrations could be a trace for emissions from the BOS Plant.

4.1.15 The average lead concentrations found on filters analysed from the Santon and Rowland Road partisols are $0.11\mu\text{g}/\text{m}^3$ and $0.22\mu\text{g}/\text{m}^3$ respectively. The annual air quality objective for lead is $0.25\mu\text{g}/\text{m}^3$. Whilst five filters from each Partisol sampler are not enough to determine the average annual concentration of lead it is possible that the annual objective for lead could be approached at the Rowland Road partisol sampler when background concentrations are considered.

4.1.16 The SEM/EDS analysis identified the presence of Ca/Mg on filters from the BOS Plant. The presence of Ca/Mg was not identified from any other process area apart from the Slag Processing Area. Significant quantities of Ca/Mg were found on filters 750 and 863 from the Santon Partisol and filters 1000 and 1145 from the Rowland Road Partisol. It is therefore possible that Ca/Mg could be used as a trace for fugitive emissions from the BOS Plant and these fugitive emissions could have contributed to elevated particulate levels at the Santon and Rowland Road monitoring stations.

Metal Recovery Plant/Slag Processing Area

4.1.17 The IC analysis of filters from the Metal Recovery Plant/Slag Processing Area showed a higher average chloride concentration than the other four process areas. However this average was skewed by a high reading from filter 52 which also showed higher concentrations of sulphate and nitrate. The composition of metal being deposited was attributed as the cause of this outlier and conditions remained reasonably similar for all the samples taken in this area. Low concentrations of all the analytes considered by the ICP analysis were found.

4.1.18 The SEM/EDS analysis indicated the presence of Ca and Ca/Si in the Slag Processing Area sample. This area is located outside and therefore significantly influenced by ambient conditions. Ca and Ca/Si presence is shown on filters from both the partisol samplers in larger percentages than shown on the Slag Processing Area filter.

4.1.19 Slag is comprised of calcium silicate (Ca_2SiO_4), lime (CaO) and dolomite lime (CaO.MgO) as well as impurities such as phosphorous, iron and manganese. Although slag is rich in these elements the background geology also contains calcium and silica as they occur naturally in the solid geology underlying the Steelworks. Whilst the Slag Processing Area may be attributing to the presence of Ca and Ca/Si on the partisol filters the presence of Ca and Ca/Si in the background geology makes the results inconclusive.

Summary of Process Area Fingerprints

4.1.20 A summary of the potential fingerprint developed above for fugitive emissions from each process area considered is detailed in Table 9.

Table 9: Summary of the Potential Fingerprint Developed for the Process Areas Considered			
Process Area	Fingerprint Development from Analysis Types		
	IC	ICP	SEM/EDS
Coke Ovens	n/a	n/a	Sodium
Sinter Plant	n/a	n/a	n/a
Blast Furnace	Sulphate	Nickel	n/a
BOS Plant	n/a	Lead	Calcium/Magnesium
Metal Recovery Plant	n/a	n/a	n/a
Slag Processing Area	n/a	n/a	Calcium and Calcium/Silicon

4.1.22 It has not been possible to identify a fingerprint for the Sinter Plant of Metal Recovery Plant at this stage. The results from the laboratory analysis have

identified specific elements present on the process area filter samples which could be used as a fingerprint for fugitive emissions from these process areas. Section 5 provides recommendations for further work which would need to be undertaken to confirm the findings of this project and further develop the fingerprint for each process area.

5 RECOMMENDATIONS FOR FURTHER WORK

5.1.1 It is recognised that further monitoring work is required to confirm the findings of the short term measurements undertaken for this project. Further recommendations are therefore made to supplement this research with additional data to aid the fingerprint development.

5.1.2 The sampling undertaken for this study included a series of five ten minute spot measures in each of the five process areas. These spot measurements were conducted at different locations within each process area to consider varying activity and emission levels. Variations in the analysis results are therefore apparent between the filters taken in each process area.

5.1.3 It is recommended that a detailed monitoring programme be undertaken using Partisol samplers, or similar continuous measurement particulate monitors, located within the process areas. The spot monitoring undertaken in this study has identified hot spot locations within the process areas where emissions are considerably higher than other areas. These hot spot locations include:

- The gantry directly above the tapping area in the Blast Furnace cast house
- The conveyor strand and ore tipping sections of the Sinter Plant

5.1.4 The Coke Ovens, BOS Plant and Metal Recovery Plant are subject to more intermittent activities and therefore it is more difficult to determine hotspot locations. It is likely that higher particulate levels are experienced in the BOS Plant during and immediately after charging, however, charging was not occurring during the spot measurements.

5.1.5 The Coke Oven samples are subject to ambient conditions as they were taken outside on top of the Coke Ovens. Wind direction and occasional breezes may therefore have been significant in obtaining consistent spot measurements. The Coke Ovens are also subject to sporadic activities as ovens are charged on a cycle basis. Occasional tipping and processing activities are also experienced at the Metal Recovery Plant and Slag Processing Areas respectively. Wind direction and speed may also have been a contributing factor in obtaining representative

samples from these areas as it was not always possible to take the samples downwind of the emission source.

5.1.6 The IC results from the Metal Recovery Plant have indicated that scrap composition is also a determining factor in terms of providing representative samples. In the spot measurements a non typical scrap composition may have produced analyte concentrations which are not generally representative of the process area emissions.

5.1.7 A more detailed sampling campaign should include the installation of Partisol samplers in the Blast Furnace, Sinter Plant and BOS Plant. These are the three process areas considered most likely to produce significant emissions of the analytes considered in the IC and ICP analyses. A Partisol sampler has not been recommended for installation on the Coke Ovens for three reasons:

- Operational procedures and weather conditions would make installing a partisol on the Coke Ovens, in a location in which a representative sample would be achieved on a daily basis, difficult.
- The Coke Oven samples also show some of the lowest concentrations of analytes considered in the ICP analysis. Whilst the Coke Oven samples do show higher concentrations of chloride the standard deviation in chloride concentrations, from both Partisol samplers, is reasonably low. This indicates that it is unlikely that chloride concentrations at these Partisol locations are overly influenced by point source emissions.
- The SEM/EDS analysis only identified sodium particles on filters taken at the Coke Ovens. It is therefore considered likely that sodium can be used as a trace element for fugitive emissions from the Coke Ovens.

5.1.8 The Partisol samplers would ideally be installed in the three process areas for a period of up to three months and should be operated using the same procedures adopted by the Local Authority for the two ambient Partisol samplers. This includes the use of the same filter papers and the same operating running times for comparison purposes. Filters from the Local Authority Partisol samplers should be obtained for the same sampling period. Process area filters and the two Partisol sampler filters should be analysed using the IC, ICP and SEM/EDS analysis techniques.

- 5.1.9 A small meteorological station should be installed in the vicinity of the process area and Local Authority Partisol samplers to record wind speed and direction, rainfall, temperature and relative humidity. Any pollution incidents occurring during the Partisol monitoring campaign should be recorded and filters from these dates for the process areas should be closely compared with those from the two Partisol samplers.
- 5.1.10 It was not possible to obtain spot samples for the slag haul road during this study due to poor weather conditions. These caused the slag haul road to be saturated and hence particulate re-suspension, from the action of vehicle on the haul road, was minimal and not able to provide a viable sample. It is recommended that spot samples be taken from the slag haul road using the same procedures as adopted during this study. This will provide an indication as to concentrations of anions and metals present on the particulates generated from the haul road as well as the particulate composition. Should the spot samples indicate that the slag haul road may be contributing to particulate concentrations at the two Local Authority Partisol samplers it may be necessary to undertake more detailed sampling, using a partisol sampler, at a representative location along the haul road.

6 CONCLUSIONS

6.1.1 Filter samples were taken at the five process areas of the steelworks and analysed using ion chromatography, inductively coupled plasma – mass spectrometry and scanning electron microscopy techniques. Filters from a back catalogue from the two partisol samplers were also analysed, using the same techniques, for comparison purposes.

6.1.2 It has been possible to identify potential trace elements for four of the process areas considered. The IC analysis identified sulphate as a potential trace for fugitive emissions from the Blast Furnace. The ICP analysis identified lead and nickel as potential traces for fugitive emissions from the Blast Furnace and BOS Plant respectively. The SEM/EDS analysis identified sodium as a potential trace elements for fugitive emissions from the Coke Oven. Calcium/magnesium and calcium/ silicon were also identified as potential trace elements for fugitive emissions from the BOS Plant and Slag Processing Area respectively.

Whilst the short term monitoring, undertaken for this project, has provided an indication of potential trace elements for four of the process areas further work, including a more detailed monitoring campaign, is required to verify these findings and provide evidence to link these process areas with elevated concentrations of PM₁₀ being recorded by the Santon and Rowland Road partisol samplers.

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Appendix A

Detailed Sampling Notes

Appendix A – Detailed Sampling Notes Taken During the Process Area Sampling Periods

Process Area	Sample Date	Sample Reference	Weather Conditions	Sample Observations
Coke Oven	03/03/2010	1, 3, 4, 7, 8, 10, 11, 13, 76	Calm, clear light breeze	Sporadic activity in the Coke Ovens. Occasional visible emissions
Coke Oven	03/03/2010	5, 6, 9	Calm, clear light breeze	A lot of activity in the Coke Ovens – multiple visible emissions
Coke Oven	04/03/2010	12, 13, 14, 15	Calm, clear light breeze	Sporadic activity in the Coke Ovens. Occasional visible emissions
Sinter Plant	04/03/2010	16, 17, 19, 20	Calm, clear light breeze through Sinter Plant throughout sampling	Sample taken mainly by open end of plant next to hopper as well as middle section
Sinter Plant	04/03/2010	21, 22, 25, 26, 27, 28	Calm, clear light breeze through Sinter Plant throughout sampling	Sample taken by open end of plant next to hopper, middle section and opposite end where ore is being tipped
Sinter Plant	04/03/2010	23, 24	Calm, clear light breeze through Sinter Plant throughout sampling	Sample taken mostly where ore is being tipped and at hopper end of Sinter Plant
Sinter Plant	04/03/2010	29, 30, 79	Calm, clear light breeze through Sinter Plant throughout sampling	Sample taken at back end of plant where ore is being tipped only
BOS Plant	04/03/2010	31, 32, 33, 34,	n/a	Sample taken on 7th floor by lift area to right side of the plant, only sporadic dust emissions - not overly visible
BOS Plant	04/03/2010	35, 36, 37, 38, 44	n/a	Sample taken on 7th floor in middle of plant - only sporadic dust emissions - not overly visible
BOS Plant	05/03/2010	42, 43, 45, 58, 59, 60	n/a	Sample taken on 7th floor in middle of plant - only sporadic dust emissions - not overly visible
Blast Furnace Cast House	03/03/2010	61, 62, 63, 64, 65, 66	n/a	Sample taken whilst stood next to molten iron flow at ground level
Blast Furnace Cast House	03/03/2010	67, 68, 69, 70	n/a	Sample taken whilst iron being poured into torpedo
Blast Furnace Cast House	03/03/2010	71, 72	n/a	Sample taken on gantry above tapping area, high sulphur levels apparent
Blast Furnace Cast House	03/03/2010	73, 74	n/a	Sample taken next to open window of chamber in which iron is being poured into torpedo (not representative of human exposure)
Blast Furnace Cast House	03/03/2010	75	n/a	Sample taken at end of tapping - mostly slag
Metal Recovery Plant	03/03/2010	46, 47, 48	Clear and dry. Light breeze with occasional stronger gusts (~ 5-10mph)	Intermittent tipping of scrap metal at metal recovery plant
Metal Recovery Plant	05/03/2010	49, 50, 51, 52, 53, 54, 55, 56, 57	Clear and dry. Light breeze with occasional stronger gusts (~5-10mph)	Sample taken in enclosure where tipping occurs from tipper truck into hopper – occasional tipping only
Slag Processing Area	05/03/2010	39, 40, 41	Clear and dry. Light breeze from south west with occasional stronger gusts (~5-10mph)	Outdoor sample. Sample taken downwind of loading/moving/tipping slag

Appendix B

Corus and Local Authority Full Ion Chromatography (IC) Analysis Mass Results

Appendix B: Ion Chromatography Filter Analysis Mass Results for Corus and Local Authority Samples

Station Name	Date Sample Taken	Filter ID	Analyte Mass (µg)							Sampling Comments
			Total Particulate	Chloride (Cl)	Standard Deviation	Sulphate (SO ₄)	Standard Deviation	Nitrate (NO ₃)	Standard Deviation	
Santon	14/01/09	750	n/a	9.83		33.70		46.20		n/a
Santon	23/03/09	818	n/a	34.60		25.50		5.17		n/a
Santon	07/05/09	863	n/a	24.30		26.60		9.33		n/a
Santon	22/09/09	1000	n/a	13.60		28.70		6.81		n/a
Santon	06/11/09	1046	n/a	27.80		27.80		43.80		n/a
Average Santon				22.03	10.20	28.46	3.17	22.26	20.83	n/a
Rowland Road	31/01/09	894	n/a	24.50		55.80		48.80		n/a
Rowland Road	19/03/09	941	n/a	6.42		65.90		112.00		n/a
Rowland Road	09/10/09	1145	n/a	23.30		27.80		23.10		n/a
Rowland Road	06/11/09	1173	n/a	29.40		21.40		45.60		n/a
Rowland Road	13/01/10	1241	n/a	3.18		61.60		61.00		n/a
Average Rowland Road				17.36	11.75	46.50	20.44	58.10	33.10	n/a
Coke Oven	03/03/10	1	47	2.19		0.58		0.78		Calm and clear with a light breeze consistant activity occuring during sampling time
Coke Oven	03/03/10	4	95	3.55		0.67		0.81		Calm and clear with a light breeze very little activity occuring during sampling time
Coke Oven	03/03/10	9	199	3.66		4.54		0.20		Calm and clear with a light breeze a lot of activity occuring during sampling time - visible fume and dust sources
Coke Oven	03/03/10	76	95	1.91		0.47		0.20		Calm and clear with a light breeze consistant activity occuring during sampling time
Coke Oven	04/03/10	13	234	4.05		1.51		0.20		Calm and clear with a light breeze consistant activity occuring during sampling time
Average Coke Oven			134	3.07	0.96	1.55	1.72	0.44	0.33	
Sinter Plant	04/03/10	16	254	1.08		2.81		0.20		Sample taken mostly at hopper end of Sinter Plant as well as middle section next to conveyor
Sinter Plant	04/03/10	19	134	0.41		0.26		0.20		Sample taken mostly at hopper end of Sinter Plant as well as middle section next to conveyor
Sinter Plant	04/03/10	24	480	1.64		2.81		0.77		Sample taken mostly where ore is being tipped and at hopper end of Sinter Plant
Sinter Plant	04/03/10	25	233	0.44		0.47		0.20		Sample taken at hopper end of Sinter Plant, in middle section next to conveyor and where ore is being tipped
Sinter Plant	05/03/10	79	890	0.93		4.45		0.20		Sample taken where ore is being tipped
Average Sinter Plant			398	0.90	0.51	2.16	1.77	0.31	0.25	
BOS Plant	04/03/10	31	577	2.44		13.70		0.20		Sample taken on 7th floor by lift area - only sporadic activity and emissions
BOS Plant	04/03/10	34	231	0.78		1.74		0.20		Sample taken on 7th floor by lift area - only sporadic activity and emissions
BOS Plant	04/03/10	37	123	2.28		3.63		0.46		Sample taken on 7th floor by lift area - only sporadic activity and emissions
BOS Plant	05/03/10	42	110	1.45		2.51		0.74		Sample taken on 7th floor in middle of plant - only sporadic activity and emissions
BOS Plant	05/03/10	43	211	1.36		4.68		0.46		Sample taken on 7th floor in middle of plant - only sporadic activity and emissions
Average BOS Plant			250	1.66	0.69	5.25	4.85	0.41	0.22	
Blast Furnace	03/03/10	61	93	1.04		0.59		0.20		Sample taken next to molton iron flow
Blast Furnace	03/03/10	64	128	0.77		0.43		0.20		Sample taken next to molton iron flow
Blast Furnace	03/03/10	67	428	1.24		0.66		0.20		Sample taken whilst molton iron was being poured into the torpedo
Blast Furnace	03/03/10	70	559	1.45		0.99		0.20		Sample taken whilst molton iron was being poured into the torpedo
Blast Furnace	03/03/10	71	407	1.93		60.50		0.20		Sample taken on gantry above tapping area, high sulphur levels apparent
Average Blast Furnace			323	1.29	0.44	12.63	26.76	0.20	0.00	
Metal Recovery Plant	03/03/10	46	105	1.14		0.62		0.20		Clear, dry, light breeze, occassional stronger gusts. Occassional tipping of scrap
Metal Recovery Plant	05/03/10	49	56	1.00		0.44		0.72		Clear, cold, quite breezy at times. Occassional tipping of scrap. Sample taken inside enclosure leading to hopper
Metal Recovery Plant	05/03/10	52	51	35.20		3.36		3.04		Clear, cold, quite breezy at times. Occassional tipping of scrap. Sample taken inside enclosure leading to hopper
Metal Recovery Plant	05/03/10	55	62	0.86		0.34		0.73		Clear, cold, quite breezy at times. Occassional tipping of scrap. Sample taken inside enclosure leading to hopper
Slag Processing Area	05/03/10	39	100	1.25		0.66		0.42		Sample taken outside downwind of slag processing area. Constant moving of slag - visible dust plumes.
Average MRP/SPA			75	7.89	15.27	1.08	1.28	1.02	1.15	

Those results shown in blue are below the detection limit of 0.4µg. For a worst case option the results have been taken as half the limit of detection for the purposes of calculating an average.

Appendix C

Corus and Local Authority Full Ion Chromatography (IC) Analyte Concentrations

Appendix C: Ion Chromatography Filter Analysis Concentration Results for Corus and Local Authority Samples

Station Name	Date Sample Taken	Filter ID	Analyte Concentration (µg/m ³)							Sampling Comments
			Total Particulate	Chloride (Cl)	Standard Deviation	Sulphate (SO ₄)	Standard Deviation	Nitrate (NO ₃)	Standard Deviation	
Santon	14/01/09	750	n/a	1.23		4.21		5.78		not available
Santon	23/03/09	818	n/a	4.33		3.19		0.65		not available
Santon	07/05/09	863	n/a	3.04		3.33		1.17		not available
Santon	22/09/09	1000	n/a	1.70		3.59		0.85		not available
Santon	06/11/09	1046	n/a	3.48		3.48		5.48		not available
Average Santon				2.75	1.28	3.56	0.40	2.78	2.60	
Rowland Road	31/01/09	894	n/a	3.06		6.98		6.10		not available
Rowland Road	19/03/09	941	n/a	0.80		8.24		14.00		not available
Rowland Road	09/10/09	1145	n/a	2.91		3.48		2.89		not available
Rowland Road	06/11/09	1173	n/a	3.68		2.68		5.70		not available
Rowland Road	13/01/10	1241	n/a	0.40		7.70		7.63		not available
Average Rowland Road				2.17	1.47	5.81	2.55	7.26	4.14	
Coke Oven	03/03/10	1	470	21.90		5.80		7.80		Calm and clear with a light breeze consistant activity occuring during sampling time
Coke Oven	03/03/10	4	950	35.50		6.70		8.10		Calm and clear with a light breeze very little activity occuring during sampling time
Coke Oven	03/03/10	9	1990	36.60		45.40		2.00		Calm and clear with a light breeze a lot of activity occuring during sampling time - visible fume and dust sources
Coke Oven	03/03/10	76	950	19.10		4.70		2.00		Calm and clear with a light breeze consistant activity occuring during sampling time
Coke Oven	04/03/10	13	2340	40.50		15.10		2.00		Calm and clear with a light breeze consistant activity occuring during sampling time
Average Coke Oven			1340	30.72	9.56	15.54	17.19	4.38	3.26	
Sinter Plant	04/03/10	16	2540	10.80		28.10		2.00		Sample taken mostly at hopper end of Sinter Plant as well as middle section next to conveyor
Sinter Plant	04/03/10	19	1340	4.10		2.60		2.00		Sample taken mostly at hopper end of Sinter Plant as well as middle section next to conveyor
Sinter Plant	04/03/10	24	4800	16.40		28.10		7.70		Sample taken mostly where ore is being tipped and at hopper end of Sinter Plant
Sinter Plant	04/03/10	25	2330	4.40		4.70		2.00		Sample taken at hopper end of Sinter Plant, in middle section next to conveyor and where ore is being tipped
Sinter Plant	05/03/10	79	8900	9.30		44.50		2.00		Sample taken where ore is being tipped
Average Sinter Plant			3982	9.00	5.08	21.60	17.72	3.14	2.55	
BOS Plant	04/03/10	31	5770	24.40		137.00		2.00		Sample taken on 7th floor by lift area - only sporadic activity and emissions
BOS Plant	04/03/10	34	2310	7.80		17.40		2.00		Sample taken on 7th floor by lift area - only sporadic activity and emissions
BOS Plant	04/03/10	37	1230	22.80		36.30		4.60		Sample taken on 7th floor by lift area - only sporadic activity and emissions
BOS Plant	05/03/10	42	1100	14.50		25.10		7.40		Sample taken on 7th floor in middle of plant - only sporadic activity and emissions
BOS Plant	05/03/10	43	2110	13.60		46.80		4.60		Sample taken on 7th floor in middle of plant - only sporadic activity and emissions
Average BOS Plant			2504	16.62	6.89	52.52	48.52	4.12	2.25	
Blast Furnace	03/03/10	61	930	10.40		5.90		2.00		Sampling taken next to molton iron flow
Blast Furnace	03/03/10	64	1280	7.70		4.30		2.00		Sampling taken next to molton iron flow
Blast Furnace	03/03/10	67	4280	12.40		6.60		2.00		Sample taken whilst molton iron was being poured into the torpedo
Blast Furnace	03/03/10	70	5590	14.50		9.90		2.00		Sample taken whilst molton iron was being poured into the torpedo
Blast Furnace	03/03/10	71	4070	19.30		605.00		2.00		Sample taken on gantry above tapping area capturing fugitive emissions rising from the tapping area. High sulphur levels apparent
Average Blast Furnace			3230	12.86	4.39	126.34	267.59	2.00	0.00	
Metal Recovery Plant	03/03/10	46	1050	11.40		6.20		2.00		Clear, dry, light breeze, occassional stronger gusts. Occassional tipping of scrap
Metal Recovery Plant	05/03/10	49	560	10.00		4.40		7.20		Clear, cold, quite breezy at times. Occassional tipping of scrap. Sample taken inside enclosure leading to hopper
Metal Recovery Plant	05/03/10	52	510	352.00		33.60		30.40		Clear, cold, quite breezy at times. Occassional tipping of scrap. Sample taken inside enclosure leading to hopper
Metal Recovery Plant	05/03/10	55	620	8.60		3.40		7.30		Clear, cold, quite breezy at times. Occassional tipping of scrap. Sample taken inside enclosure leading to hopper
Slag Processing Area	05/03/10	39	1000	12.50		6.60		4.20		Sample taken outside downwind of slag processing area. Constant moving of slag - visible dust plumes.
Average MRP/SPA			748	78.90	152.67	10.84	12.79	10.22	11.50	

Those results shown in blue are below the detection limit. For a worst case option the results have been taken as half the limit of detection for the purposes of calculating an average.

Appendix D

Corus and Local Authority Full Inductively Coupled Plasma – Mass Spectrometry (ICP-MS) Analysis Mass Results

Appendix D - ICP Mass Filter Analysis Results for Corus and Local Authority Samples

Sample Location	Date Sample Taken	Filter ID	Analyte Mass (µg)												Sampling Comments
			Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Mangagese	Mercury	Nickel	Phosphorus	Vanadium	Zinc	
Analysis Method			ICP-MS	ICP-MS	ICP-MS	ICP-AES	ICP-AES	ICP-MS	ICP-AES	ICP-MS	ICP-MS	ICP-AES	ICP-MS	ICP-AES	
Santon	14/01/2009	750	0.1	0.01	0.98	0.1	84	0.8	5.6	0.03	0.07	1.5	0.5	450	not available
Santon	23/03/2009	818	0.14	0.02	1	0.1	67	0.3	3.6	0.03	0.1	2.4	0.54	480	not available
Santon	07/05/2009	863	0.17	0.02	1.5	0.2	71	0.6	3	0.03	0.2	1.9	0.47	440	not available
Santon	22/09/2009	1000	0.12	0.01	0.99	0.1	66	0.5	2.3	0.03	0.2	0.73	0.53	450	not available
Santon	06/11/2009	1046	0.17	0.04	0.96	0.3	48	2.3	1.9	0.03	0.1	0.2	0.45	440	not available
Average Santon			0.14	0.02	1.086	0.16	67.2	0.9	3.28	0.03	0.134	1.346	0.498	452	
Rowland Road	31/01/2009	894	0.12	0.01	0.95	0.1	61	0.5	1.9	0.03	0.1	0.9	0.46	450	not available
Rowland Road	19/03/2009	941	0.13	0.01	1.1	0.1	47	1.1	1.1	0.03	0.2	0.7	0.47	490	not available
Rowland Road	09/10/2009	1145	0.14	0.02	0.95	0.2	70	5.2	3.4	0.03	0.1	0.6	0.44	440	not available
Rowland Road	06/11/2009	1173	0.19	0.03	1	0.4	30	1.5	0.44	0.03	0.1	0.02	0.41	450	not available
Rowland Road	13/01/2010	1241	0.11	0.01	0.91	0.2	44	0.6	1	0.03	0.1	1.1	0.46	410	not available
Average Rowland Road			0.138	0.016	0.982	0.2	50.4	1.78	1.568	0.03	0.12	0.664	0.448	448	
Coke Oven	03/03/2010	3	0.01	0.004	0.23	0.02	1.5	0.1	0.2	0.03	0.7	0.25	0.19	0.56	Calm and clear with a light breeze consistant activity occuring during sampling time
Coke Oven	03/03/2010	8	0.02	0.004	0.32	0.02	0.67	0.035	1.8	0.03	0.91	0.25	0.26	0.3	Calm and clear with a light breeze very little activity occuring during sampling time
Coke Oven	03/03/2010	6	0.02	0.004	0.26	0.02	0.46	0.035	0.45	0.03	0.3	0.25	0.19	0.025	Calm and clear with a light breeze a lot of activity occuring during sampling time - visible fume and dust sources
Coke Oven	03/03/2010	11	0.01	0.004	0.25	0.2	0.72	0.09	0.21	0.03	0.3	0.25	0.27	0.025	Calm and clear with a light breeze consistant activity occuring during sampling time
Coke Oven	04/03/2010	14	0.006	0.004	0.36	0.02	1.4	0.08	0.33	0.03	0.4	0.25	0.26	0.025	Calm and clear with a light breeze consistant activity occuring during sampling time
Average Coke Oven Roof			0.0132	0.004	0.284	0.056	0.95	0.068	0.598	0.03	0.522	0.25	0.234	0.187	
Sinter Plant	04/03/2010	17	0.01	0.004	0.23	0.02	12	0.1	0.23	0.03	0.035	0.25	0.17	1.4	Sample taken mostly at hopper end of Sinter Plant as well as middle section next to conveyor
Sinter Plant	04/03/2010	22	0.02	0.004	0.33	0.02	120	0.3	1.9	0.03	0.035	0.25	0.029	0.77	Sample taken at hopper end of Sinter Plant as well as middle section next to conveyor and where ore is being tipped
Sinter Plant	04/03/2010	23	0.02	0.004	0.32	0.09	61	0.4	1.3	0.03	0.035	0.25	0.24	0.81	Sample taken mostly where ore is being tipped and at hopper end of Sinter Plant
Sinter Plant	04/03/2010	28	0.02	0.004	0.34	0.07	96	0.5	1.8	0.03	0.035	0.25	0.29	1.6	Sample taken at hopper end of Sinter Plant, in middle section next to conveyor and where ore is being tipped
Sinter Plant	05/03/2010	29	0.02	0.004	0.39	0.2	76	0.4	1.5	0.03	0.035	0.25	0.24	1.7	Sample taken where ore is being tipped
Average Sinter Plant			0.018	0.004	0.322	0.08	73	0.34	1.346	0.03	0.035	0.25	0.1938	1.256	
BOS Plant	04/03/2010	32	0.01	0.004	0.27	0.1	130	1.7	25	0.07	0.035	0.25	0.13	1.2	Sample taken on 7th floor by lift area - only sporadic activity and emissions
BOS Plant	04/03/2010	35	0.009	0.004	0.26	0.02	25	0.4	1.4	0.03	0.07	0.25	0.083	0.4	Sample taken on 7th floor by lift area - only sporadic activity and emissions
BOS Plant	04/03/2010	38	0.01	0.004	0.24	0.02	16	0.5	1.1	0.03	0.035	0.25	0.12	0.025	Sample taken on 7th floor by lift area - only sporadic activity and emissions
BOS Plant	05/03/2010	60	0.02	0.004	0.25	0.02	42	3.7	1.5	0.03	0.035	0.25	0.11	0.08	Sample taken on 7th floor in middle of plant - only sporadic activity and emissions
BOS Plant	05/03/2010	59	0.02	0.004	0.24	0.02	16	3.9	4.1	0.03	0.035	0.25	0.23	0.4	Sample taken on 7th floor in middle of plant - only sporadic activity and emissions
Average BOS Plant			0.0138	0.004	0.252	0.036	45.8	2.04	6.62	0.038	0.042	0.25	0.1346	0.421	
Blast Furnance	03/03/2010	62	0.02	0.004	0.24	0.02	7.8	0.035	0.23	0.03	0.6	0.25	0.27	0.025	Sample taken next to molton iron flow
Blast Furnance	03/03/2010	65	0.02	0.004	0.22	0.02	4	0.08	0.54	0.03	0.8	0.25	0.16	0.025	Sample taken next to molton iron flow
Blast Furnance	03/03/2010	68	0.01	0.004	0.27	0.1	70	0.3	1.5	0.03	0.76	0.25	0.3	0.86	Sample taken whilst molton iron was being poured into the torpedo
Blast Furnance	03/03/2010	72	0.02	0.004	0.26	0.02	110	0.2	3.4	0.03	0.85	0.25	0.24	2	Sample taken on gantry above tapping area, high sulphur levels apparent
Blast Furnance	03/03/2010	73	0.11	0.004	0.49	0.3	560	0.7	3.9	0.03	1.4	0.25	0.76	1.6	Sample taken next to open window where molton iron being tipped into torpedo
Average Blast Furnace Cast House			0.036	0.004	0.296	0.092	150.36	0.263	1.914	0.03	0.882	0.25	0.346	0.902	
Metal Recovery Plant	03/03/2010	47	0.02	0.004	0.23	0.02	1	0.035	0.52	0.03	0.3	0.25	0.22	0.025	Clear, dry, light breeze, occassional stronger gusts. Occassional tipping of scrap
Metal Recovery Plant	05/03/2010	50	0.02	0.004	0.32	0.02	2.1	0.5	0.5	0.03	0.035	0.25	0.24	0.2	Clear, cold, quite breezy at times. Occassional tipping of scrap. Sample taken inside enclosure leading to hopper
Metal Recovery Plant	05/03/2010	53	0.02	0.004	0.25	0.02	4	0.035	0.55	0.03	0.035	0.25	0.15	0.025	Clear, cold, quite breezy at times. Occassional tipping of scrap. Sample taken inside enclosure leading to hopper
Metal Recovery Plant	05/03/2010	56	0.03	0.004	0.2	0.02	1.6	0.035	0.21	0.03	0.035	0.25	0.24	0.025	Clear, cold, quite breezy at times. Occassional tipping of scrap. Sample taken inside enclosure leading to hopper
Slag Processing Area	05/03/2010	40	0.02	0.01	0.31	0.02	0.53	0.1	0.06	0.03	0.035	0.6	0.24	0.025	Sample taken ouside downwind of slag processing area. Constant moving of slag - visible dust plumes.
Average MRP/SPA			0.022	0.0052	0.262	0.02	1.846	0.141	0.368	0.03	0.088	0.32	0.218	0.06	

Those results shown in blue are below the detection limit. Limit of detections are as follows:

- Cadmium0.008µg
- Copper0.04µg
- Lead0.07µg
- Mercury0.06µg
- Nickel0.07µg
- Phosphorous0.5µg
- Zinc0.05µg

For a worst case option the results have been taken as half the limit of detection for the purposes of calculating an average.

Appendix E

Corus and Local Authority Full Inductively Coupled Plasma – Mass Spectrometry (ICP-MS) Analyte Concentrations

Appendix E - ICP Concentration Filter Analysis Results for Corus and Local Authority Samples

Sample Location	Date Sample Taken	Filter ID	Analyte Concentration (µg/m³)												Sampling Comments
			Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Mangagese	Mercury	Nickel	Phosphorus	Vanadium	Zinc	
Analysis Method			ICP-MS	ICP-MS	ICP-MS	ICP-AES	ICP-AES	ICP-MS	ICP-AES	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-AES	
Santon	14/01/09	750	0.013	0.001	0.123	0.013	10.500	0.100	0.700	0.004	0.009	0.188	0.063	56.250	not available
Santon	23/03/09	818	0.018	0.003	0.125	0.013	8.375	0.038	0.450	0.004	0.013	0.300	0.068	60.000	not available
Santon	07/05/09	863	0.021	0.003	0.188	0.025	8.875	0.075	0.375	0.004	0.025	0.238	0.059	55.000	not available
Santon	22/09/09	1000	0.015	0.001	0.124	0.013	8.250	0.063	0.288	0.004	0.025	0.091	0.066	56.250	not available
Santon	06/11/09	1046	0.021	0.005	0.120	0.038	6.000	0.288	0.238	0.004	0.013	0.025	0.056	55.000	not available
Average - Santon			0.02	0.003	0.14	0.02	8.40	0.11	0.41	0.004	0.02	0.17	0.062	56.50	
Standard Deviation - Santon			0.004	0.002	0.03	0.01	1.61	0.10	0.18	0.00	0.01	0.11	0.005	2.05	
Rowland Road	31/01/09	894	0.015	0.001	0.119	0.013	7.625	0.063	0.238	0.004	0.013	0.113	0.058	56.250	not available
Rowland Road	19/03/09	941	0.016	0.001	0.138	0.013	5.875	0.138	0.138	0.004	0.025	0.088	0.059	61.250	not available
Rowland Road	09/10/09	1145	0.018	0.003	0.119	0.025	8.750	0.650	0.425	0.004	0.013	0.075	0.055	55.000	not available
Rowland Road	06/11/09	1173	0.024	0.004	0.125	0.050	3.750	0.188	0.055	0.004	0.013	0.003	0.051	56.250	not available
Rowland Road	13/01/10	1241	0.014	0.001	0.114	0.025	5.500	0.075	0.125	0.004	0.013	0.138	0.058	51.250	not available
Average - Rowland Road			0.02	0.002	0.12	0.03	6.30	0.22	0.20	0.004	0.02	0.08	0.056	56.00	
Standard Deviation - Rowland Road			0.004	0.001	0.01	0.02	1.94	0.24	0.14	0.00	0.01	0.05	0.003	3.58	
Coke Oven	03/03/10	3	0.10	0.04	2.30	0.20	15.00	1.00	2.00	0.30	7.00	2.50	1.90	5.60	Calm and clear with a light breeze consistant activity occuring during sampling time
Coke Oven	03/03/10	8	0.20	0.04	3.20	0.20	6.70	0.35	18.00	0.30	9.10	2.50	2.60	3.00	Calm and clear with a light breeze very little activity occuring during sampling time
Coke Oven	03/03/10	6	0.20	0.04	2.60	0.20	4.60	0.35	4.50	0.30	3.00	2.50	1.90	0.25	Calm and clear with a light breeze a lot of activity occuring during sampling time - visible fume and dust sources
Coke Oven	03/03/10	11	0.10	0.04	2.50	2.00	7.20	0.90	2.10	0.30	3.00	2.50	2.70	0.25	Calm and clear with a light breeze consistant activity occuring during sampling time
Coke Oven	04/03/10	14	0.06	0.04	3.60	0.20	14.00	0.80	3.30	0.30	4.00	2.50	2.60	0.25	Calm and clear with a light breeze consistant activity occuring during sampling time
Average - Coke Oven Roof			0.13	0.04	2.84	0.56	9.50	0.68	5.98	0.30	5.22	2.50	2.34	1.87	
Standard Deviation - Coke Oven Roof			0.06	0.00	0.54	0.80	4.68	0.31	6.80	0.00	2.72	0.00	0.40	2.40	
Sinter Plant	04/03/10	17	0.10	0.04	2.30	0.20	120.00	1.00	2.30	0.30	0.35	2.50	1.70	14.00	Sample taken mostly at hopper end of Sinter Plant as well as middle section next to conveyor
Sinter Plant	04/03/10	22	0.20	0.04	3.30	0.20	1200.00	3.00	19.00	0.30	0.35	2.50	0.29	7.70	Sample taken at hopper end of plant and middle section next to conveyor and where ore is being tipped
Sinter Plant	04/03/10	23	0.20	0.04	3.20	0.90	610.00	4.00	13.00	0.30	0.35	2.50	2.40	8.10	Sample taken mostly where ore is being tipped and at hopper end of Sinter Plant
Sinter Plant	04/03/10	28	0.20	0.04	3.40	0.70	960.00	5.00	18.00	0.30	0.35	2.50	2.90	16.00	Sample taken at hopper end of Sinter Plant, in middle section next to conveyor and where ore is being tipped
Sinter Plant	05/03/10	29	0.20	0.04	3.90	2.00	760.00	4.00	15.00	0.30	0.35	2.50	2.40	17.00	Sample taken where ore is being tipped
Average - Sinter Plant			0.18	0.04	3.22	0.80	730.00	3.40	13.46	0.30	0.35	2.50	1.94	12.56	
Standard Deviation - Sinter Plant			0.04	0.00	0.58	0.74	406.57	1.52	6.68	0.00	0.00	0.00	1.02	4.39	
BOS Plant	04/03/10	32	0.10	0.04	2.70	1.00	1300.00	17.00	250.00	0.70	0.35	2.50	1.30	12.00	Sample taken on 7th floor by lift area - only sporadic activity and emissions
BOS Plant	04/03/10	35	0.09	0.04	2.60	0.20	250.00	4.00	14.00	0.30	0.70	2.50	0.83	4.00	Sample taken on 7th floor by lift area - only sporadic activity and emissions
BOS Plant	04/03/10	38	0.10	0.04	2.40	0.20	160.00	5.00	11.00	0.30	0.35	2.50	1.20	0.25	Sample taken on 7th floor by lift area - only sporadic activity and emissions
BOS Plant	05/03/10	60	0.20	0.04	2.50	0.20	420.00	37.00	15.00	0.30	0.35	2.50	1.10	0.80	Sample taken on 7th floor in middle of plant - only sporadic activity and emissions
BOS Plant	05/03/10	59	0.20	0.04	2.40	0.20	160.00	39.00	41.00	0.30	0.35	2.50	2.30	4.00	Sample taken on 7th floor in middle of plant - only sporadic activity and emissions
Average - BOS Plant			0.14	0.04	2.52	0.36	458.00	20.40	66.20	0.38	0.42	2.50	1.35	4.21	
Standard Deviation - BOS Plant			0.06	0.00	0.13	0.36	482.51	16.88	103.45	0.18	0.16	0.00	0.56	4.69	
Blast Furnance	03/03/10	62	0.20	0.04	2.40	0.20	78.00	0.35	2.30	0.30	6.00	2.50	2.70	0.25	Sample taken next to molton iron flow
Blast Furnance	03/03/10	65	0.20	0.04	2.20	0.20	40.00	0.80	5.40	0.30	8.00	2.50	1.60	0.25	Sample taken next to molton iron flow
Blast Furnance	03/03/10	68	0.10	0.04	2.70	1.00	700.00	3.00	15.00	0.30	7.60	2.50	3.00	8.60	Sample taken whilst molton iron was being poured into the torpedo
Blast Furnance	03/03/10	72	0.20	0.04	2.60	0.20	1100.00	2.00	34.00	0.30	8.50	2.50	2.40	20.00	Sample taken on gantry above tapping area, high sulphur levels apparent
Blast Furnance	03/03/10	73	1.10	0.04	4.90	3.00	5600.00	7.00	39.00	0.30	14.00	2.50	7.60	16.00	Sample taken next to open window where molton iron being tipped into torpedo
Average - Blast Furnace Cast House			0.36	0.04	2.96	0.92	1503.60	2.63	19.14	0.30	8.82	2.50	3.46	9.02	
Standard Deviation - Blast Furnace			0.42	0.00	1.10	1.21	2332.57	2.65	16.62	0.00	3.04	0.00	2.37	8.99	
Metal Recovery Plant	03/03/10	47	0.20	0.04	2.30	0.20	10.00	0.35	5.20	0.30	3.00	2.50	2.20	0.25	Clear, dry, light breeze, occassional stronger gusts. Occassional tipping of scrap
Metal Recovery Plant	05/03/10	50	0.20	0.04	3.20	0.20	21.00	5.00	5.00	0.30	0.35	2.50	2.40	2.00	Clear, cold, quite breezy at times. Occassional tipping of scrap. Sample taken inside enclosure leading to hopper
Metal Recovery Plant	05/03/10	53	0.20	0.04	2.50	0.20	40.00	0.35	5.50	0.30	0.35	2.50	1.50	0.25	Clear, cold, quite breezy at times. Occassional tipping of scrap. Sample taken inside enclosure leading to hopper
Metal Recovery Plant	05/03/10	56	0.30	0.04	2.00	0.20	16.00	0.35	2.10	0.30	0.35	2.50	2.40	0.25	Clear, cold, quite breezy at times. Occassional tipping of scrap. Sample taken inside enclosure leading to hopper
Slag Processing Area	05/03/10	40	0.20	0.10	3.10	0.20	5.30	1.00	0.60	0.30	0.35	6.00	2.40	0.25	Sample taken ouside downwind of slag processing area. Constant moving of slag - visible dust plumes.
Average MRP/SPA			0.22	0.05	2.62	0.20	18.46	1.41	3.68	0.30	0.88	3.20	2.18	0.60	
Standard Deviation - MRP/SPA			0.04	0.03	0.52	0.00	13.43	2.03	2.20	0.00	1.19	1.57	0.39	0.78	

Those results shown in blue are below the detection limit. For a worst case option the results have been taken as half the limit of detection for the purposes of calculating an average.

Appendix F

Corus and Local Authority Full Scanning Electron Microscopy – Energy Dispersive Spectroscopy (SEM/EDS) Analysis Results

Appendix G

Corus and Local Authority SEM Laboratory Analysis Results and SEM Photomicrographs

Appendix G: SEM-EDS Photomicrographs for the Five Steelworks Process Areas and the Two Partisol Monitoring

Sample Location	Date Sample Taken	Filter ID	SEM Photomicrograph Reference
Santon Partisol Monitor	14/01/2009	750	016360
Santon Partisol Monitor	21/03/2009	816	016962
Santon Partisol Monitor	23/03/2009	818	016356
Santon Partisol Monitor	07/05/2009	863	016357
Santon Partisol Monitor	08/05/2009	864	016963
Santon Partisol Monitor	20/08/2009	968	016964
Santon Partisol Monitor	21/09/2009	999	016965
Santon Partisol Monitor	22/09/2009	1000	016359
Santon Partisol Monitor	06/11/2009	1046	016358
Santon Partisol Monitor	18/02/2010	1151	016966
Rowland Road Partisol Monitor	01/01/2009	864	016971
Rowland Road Partisol Monitor	30/01/2009	893	016967
Rowland Road Partisol Monitor	31/01/2009	894	016355
Rowland Road Partisol Monitor	18/03/2009	940	016970
Rowland Road Partisol Monitor	19/03/2009	941	016351
Rowland Road Partisol Monitor	09/10/2009	1145	016352
Rowland Road Partisol Monitor	06/11/2009	1173	016353
Rowland Road Partisol Monitor	13/01/2010	1241	016354
Rowland Road Partisol Monitor	14/01/2010	1242	016969
Rowland Road Partisol Monitor	19/02/2010	1278	016968
Coke Oven	03/03/2010	00983/05	15398
Coke Oven	03/03/2010	00983/07	15395
Coke Oven	03/03/2010	00983/10	15401
Coke Oven	04/03/2010	00983/12	15404
Coke Oven	04/03/2010	00983/15	15407
Sinter Plant	04/03/2010	00983/20	15363
Sinter Plant	04/03/2010	00983/21	15366
Sinter Plant	04/03/2010	00983/26	15369
Sinter Plant	04/03/2010	00983/27	15372
Sinter Plant	04/03/2010	00983/30	15375
Blast Furnace Cast House	03/03/2010	00983/63	15378
Blast Furnace Cast House	03/03/2010	00983/66	15381
Blast Furnace Cast House	03/03/2010	00983/69	15384
Blast Furnace Cast House	03/03/2010	00983/74	15389
Blast Furnace Cast House	03/03/2010	00983/75	15390
BOS Plant	04/03/2010	00983/33	15347
BOS Plant	04/03/2010	00983/36	15350
BOS Plant	04/03/2010	00983/44	15359
BOS Plant	05/03/2010	00983/45	15356
BOS Plant	05/03/2010	00983/58	15353
Metal Recovery Plant	03/03/2010	00983/48	15410
Metal Recovery Plant	05/03/2010	00983/51	15416
Metal Recovery Plant	05/03/2010	00983/54	15425
Metal Recovery Plant	05/03/2010	00983/57	15421
Slag Processing Area	05/03/2010	00983/41	15413

OCCUPATIONAL HYGIENE & ENVIRONMENTAL MONITORING LABORATORY

RESULTS OF EXAMINATION BY SEM-EDS


Ms R McCollom	Report Number:	OHEM 02249/SEM/0001, Rev 0
Environmental Scientist	Job Number:	OHEM 02249
Wardell Armstrong LLP	Date Received:	06 April 2010
2 The Avenue	Date Analysed:	23 April 2010
Leigh	Sample Description:	PM10 GLA47mm Filter Ref ST2 750
WN7 1ES	TES Sample ID Number:	016360
	Issue Date:	21 May, 2010
	Page:	10 of 10

Identification of Dust Gauge / Environmental Deposits by SEM-EDS Method Number SEMDG7

Category	Section 1 Estimated %	Section 2 Estimated %	Section 3 Estimated %	Section 4 Estimated %	Section 5 Estimated %	Average Estimated %
Calcium/sulphur rich	15	3	*	18	*	7
Carbonaceous matter	10	2	8	5	10	7
Iron rich	10	25	8	10	5	12
Calcium/aluminium/ silicon rich	7	*	5	8	5	5
Silicon rich	5	5	*	7	2	4
Calcium rich	45	35	50	35	43	42
Aluminium/silicon rich	*	*	2	*	*	<1
Animal/plant fragment	*	2	*	2	*	<1
Calcium/magnesium	*	28	25	15	30	20
Calcium/silicon rich	8	*	2	*	5	3

- 99% of particles present were <10µm in size.
- The examination procedure is based on an assessment of forty individual particles selected at random.
- The estimated percentage is based on a comparison of the relative number of particles counted in each category.
- TES Bretby does not accept responsibility for the sampling associated with the results reported above.
- Opinions and interpretations expressed herein are outside the scope of our UKAS accreditation.

Analysed by:


D Rayson, SEM Analyst

Analysed &
Authorised by:

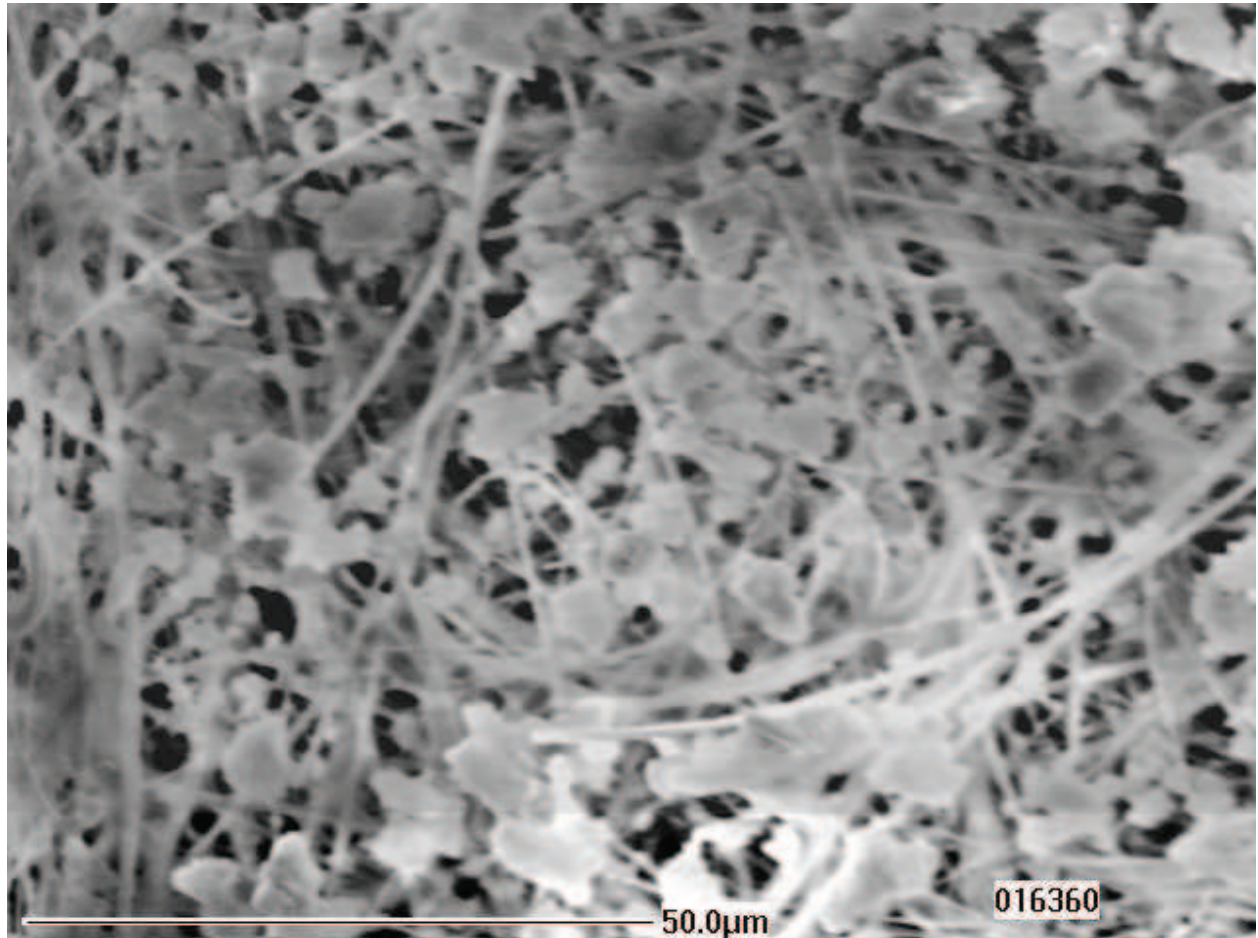

D A Cowper, SEM Senior Analyst
Direct Dial: 01283 554462

SEM-EDS Photomicrographs

Santon Partisol Monitoring Location

Filter ID 750

Date Sample Taken – 14/01/2009



OCCUPATIONAL HYGIENE & ENVIRONMENTAL MONITORING LABORATORY

RESULTS OF EXAMINATION BY SEM-EDS

Ms R McCollom	Report Number:	OHEM 02349/SEM/0001, Rev 0
Environmental Scientist	Job Number:	OHEM 02349
Wardell Armstrong LLP	Date Received:	19 April 2010
2 The Avenue	Date Analysed:	16 June 2010
Leigh	Sample Description:	PM10 GLA47mm Filter Ref ST2 816
WN7 1ES	TES Sample ID Number:	016962
	Issue Date:	18 June, 2010
	Page:	1 of 10

Identification of Dust Gauge / Environmental Deposits by SEM-EDS Method Number SEMDG7

Category	Section 1 Estimated %	Section 2 Estimated %	Section 3 Estimated %	Section 4 Estimated %	Section 5 Estimated %	Average Estimated %
Calcium/sulphur rich	5	5	15	17	*	8
Carbonaceous matter	10	5	5	*	7	5
Iron rich	5	13	7	*	7	6
Aluminium/silicon/ calcium rich	15	15	12	23	23	18
Aluminium/silicon/ potassium rich	15	35	23	23	33	26
Calcium rich	5	5	*	*	*	2
Aluminium/silicon rich	10	12	5	7	*	7
Silicon/calcium rich	*	*	5	*	*	1
Silicon rich	30	10	28	30	25	25
Animal/Plant fragments	5	*	*	*	5	2

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- Opinions and interpretations expressed herein are outside the scope of our UKAS accreditation.

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Authorised by:



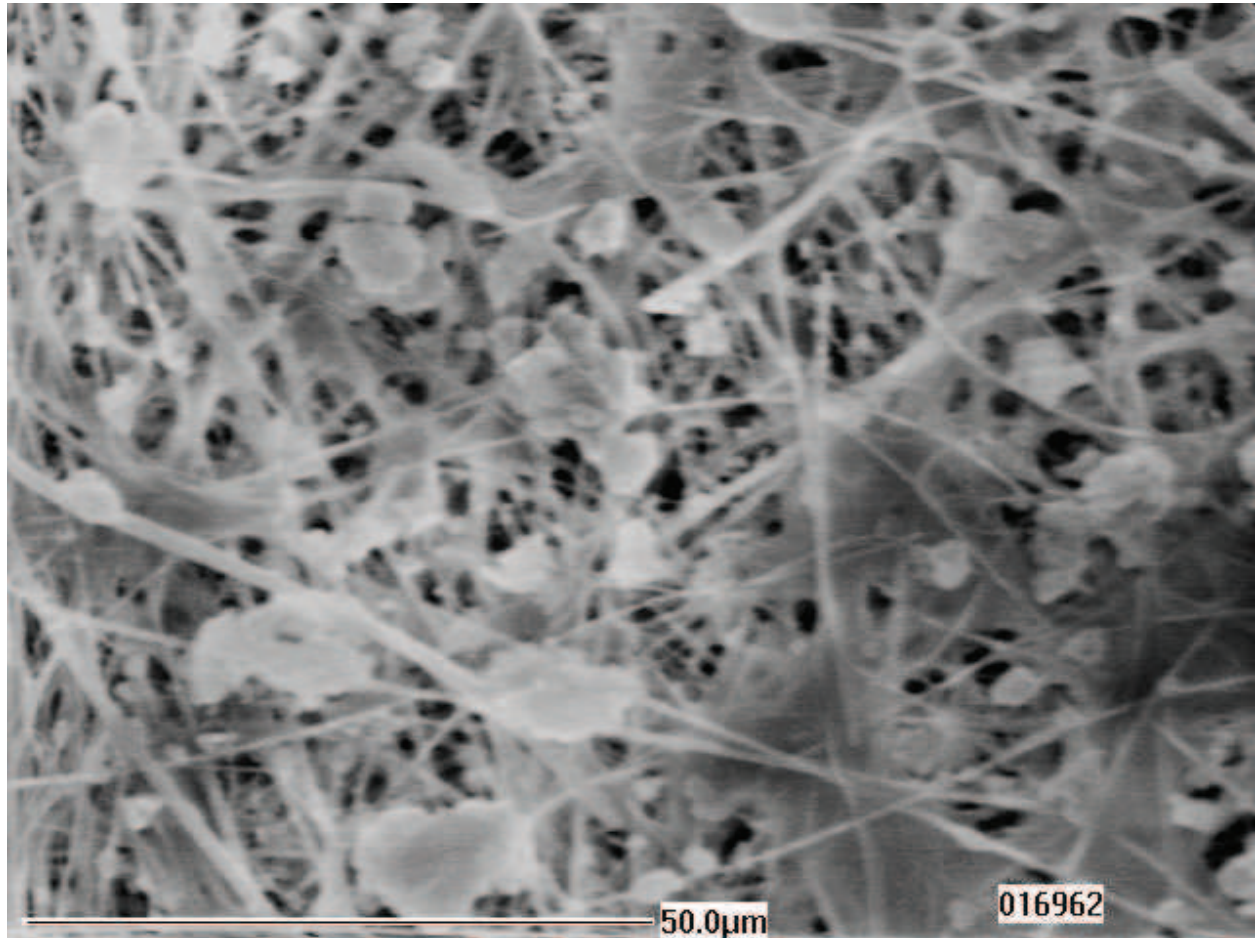
D A Cowper, SEM Senior Analyst
Direct Dial: 01283 554462

SEM-EDS Photomicrographs

Santon Partisol Monitoring Location

Filter ID 816

Date Sample Taken – 21/03/2009



OCCUPATIONAL HYGIENE & ENVIRONMENTAL MONITORING LABORATORY

RESULTS OF EXAMINATION BY SEM-EDS

Ms R McCollom	Report Number:	OHEM 02249/SEM/0001, Rev 0
Environmental Scientist	Job Number:	OHEM 02249
Wardell Armstrong LLP	Date Received:	06 April 2010
2 The Avenue	Date Analysed:	20/21 April 2010
Leigh	Sample Description:	PM10 GLA47mm Filter Ref ST2 818
WN7 1ES	TES Sample ID Number:	016356
	Issue Date:	21 May, 2010
	Page:	6 of 10

Identification of Dust Gauge / Environmental Deposits by SEM-EDS Method Number SEMDG7

Category	Section 1 Estimated %	Section 2 Estimated %	Section 3 Estimated %	Section 4 Estimated %	Section 5 Estimated %	Average Estimated %
Calcium/sulphur rich	18	*	2	2	5	5
Carbonaceous matter	28	30	10	12	13	19
Iron rich	7	2	*	*	5	3
Calcium/aluminium/ silicon rich	15	25	40	40	30	30
Aluminium/silicon/ potassium rich	2	5	20	*	13	8
Silicon rich	18	15	13	13	2	12
Calcium rich	*	*	*	*	5	1
Aluminium/silicon rich	12	23	13	18	15	16
Sodium/chlorine rich	*	*	*	*	7	1
Calcium/magnesium rich	*	*	*	*	5	1
Calcium/silicon rich	*	*	2	15	*	3

- 99% of particles present were <10µm in size.
- The examination procedure is based on an assessment of forty individual particles selected at random.
- The estimated percentage is based on a comparison of the relative number of particles counted in each category.
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- Opinions and interpretations expressed herein are outside the scope of our UKAS accreditation.

Analysed by: 
D Rayson, SEM Analyst

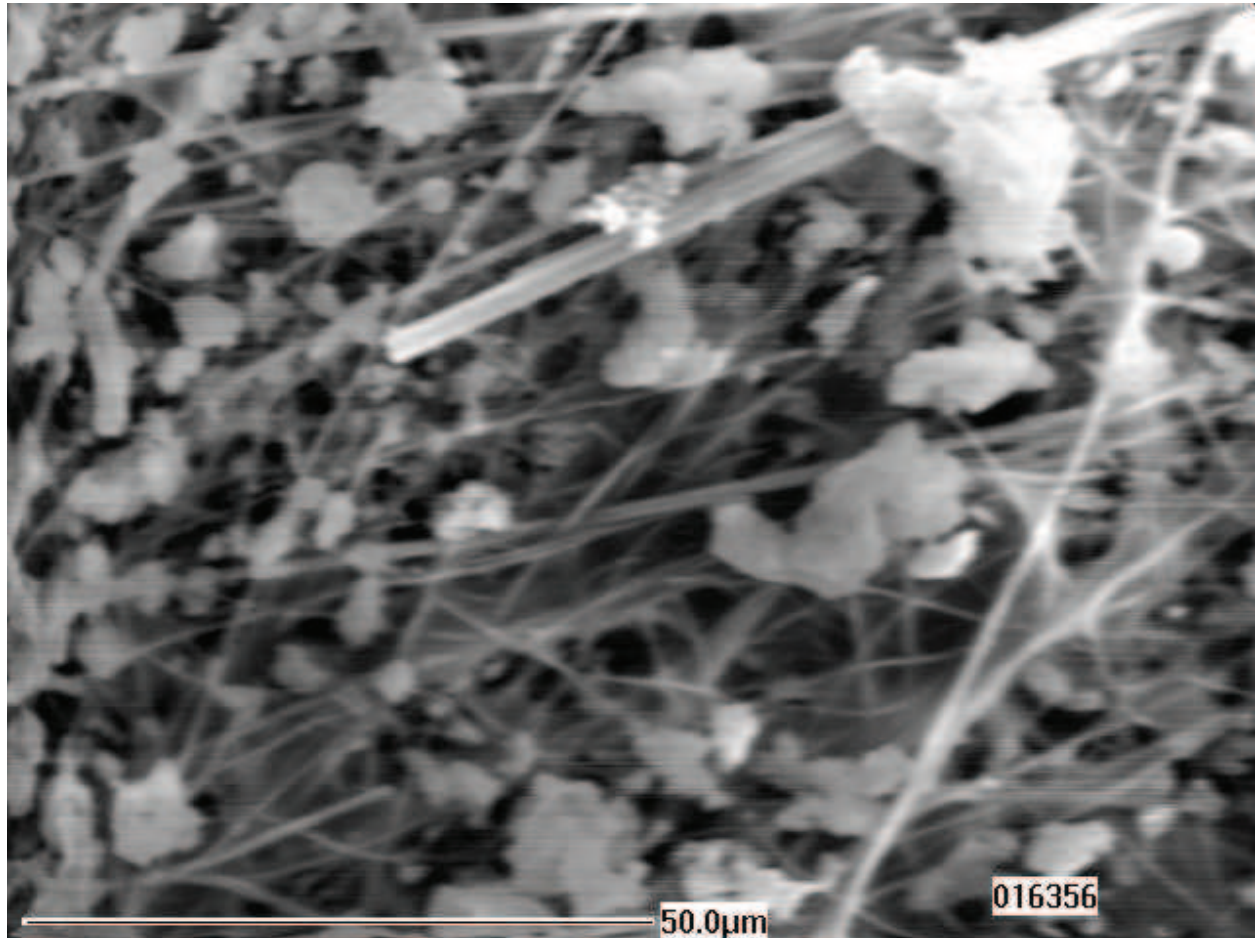
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Authorised by: 
D A Cowper, SEM Senior Analyst
Direct Dial: 01283 554462

SEM-EDS Photomicrographs

Santon Partisol Monitoring Location

Filter ID 818

Date Sample Taken – 23/03/2009



OCCUPATIONAL HYGIENE & ENVIRONMENTAL MONITORING LABORATORY

RESULTS OF EXAMINATION BY SEM-EDS


Ms R McCollom	Report Number:	OHEM 02249/SEM/0001, Rev 0
Environmental Scientist	Job Number:	OHEM 02249
Wardell Armstrong LLP	Date Received:	06 April 2010
2 The Avenue	Date Analysed:	20/21 April 2010
Leigh	Sample Description:	PM10 GLA47mm Filter Ref ST2 863
WN7 1ES	TES Sample ID Number:	016357
	Issue Date:	21 May, 2010
	Page:	7 of 10

Identification of Dust Gauge / Environmental Deposits by SEM-EDS Method Number SEMDG7

Category	Section 1 Estimated %	Section 2 Estimated %	Section 3 Estimated %	Section 4 Estimated %	Section 5 Estimated %	Average Estimated %
Calcium/sulphur rich	*	2	5	*	8	3
Carbonaceous matter	25	28	27	33	35	30
Iron rich	8	15	10	*	12	9
Calcium/aluminium/ silicon rich	5	*	*	*	2	1
Aluminium/silicon/ potassium rich	*	*	2	2	*	<1
Silicon rich	*	2	5	*	*	1
Calcium rich	12	18	13	25	20	18
Aluminium/silicon rich	5	*	13	5	*	5
Sodium/chlorine rich	15	7	13	7	8	10
Calcium/magnesium rich	12	13	7	18	10	12
Calcium/silicon rich	18	13	5	10	5	10
Magnesium/sulphur rich	*	2	*	*	*	<1

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- Opinions and interpretations expressed herein are outside the scope of our UKAS accreditation.

Analysed by:


D Rayson, SEM Analyst

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Authorised by:



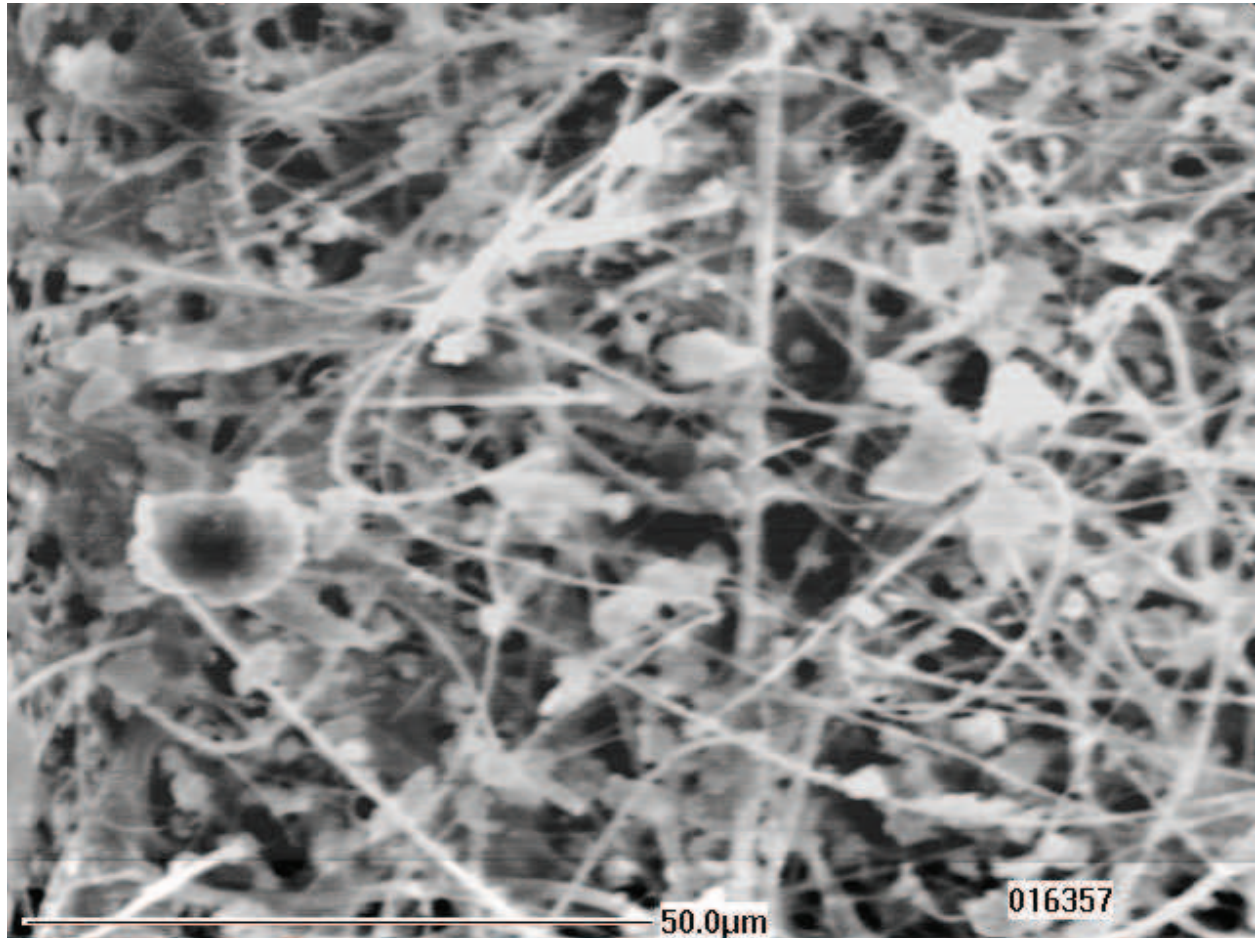
D A Cowper, SEM Senior Analyst
Direct Dial: 01283 554462

SEM-EDS Photomicrographs

Santon Partisol Monitoring Location

Filter ID 863

Date Sample Taken – 07/05/2009



OCCUPATIONAL HYGIENE & ENVIRONMENTAL MONITORING LABORATORY

RESULTS OF EXAMINATION BY SEM-EDS

Ms R McCollom	Report Number:	OHEM 02349/SEM/0001, Rev 0
Environmental Scientist	Job Number:	OHEM 02349
Wardell Armstrong LLP	Date Received:	19 April 2010
2 The Avenue	Date Analysed:	14 June 2010
Leigh	Sample Description:	PM10 GLA47mm Filter Ref ST2 864
WN7 1ES	TES Sample ID Number:	016963
	Issue Date:	18 June, 2010
	Page:	2 of 10

Identification of Dust Gauge / Environmental Deposits by SEM-EDS Method Number SEMDG7

Category	Section 1 Estimated %	Section 2 Estimated %	Section 3 Estimated %	Section 4 Estimated %	Section 5 Estimated %	Average Estimated %
Carbonaceous matter	13	10	15	10	23	14
Iron rich	10	10	7	8	8	9
Calcium rich	10	*	7	12	7	7
Aluminium/silicon/ calcium rich	23	38	25	13	10	22
Aluminium/silicon/ potassium rich	10	5	5	2	*	4
Calcium/Silicon rich	10	15	10	30	23	18
Aluminium/silicon rich	10	*	*	*	5	3
Silicon rich	12	15	18	18	15	16
Sodium/chlorine rich	2	2	5	5	7	4
Animal/plant fragments	*	5	8	2	2	3

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- The examination procedure is based on an assessment of forty individual particles selected at random.
- The estimated percentage is based on a comparison of the relative number of particles counted in each category.
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- Opinions and interpretations expressed herein are outside the scope of our UKAS accreditation.

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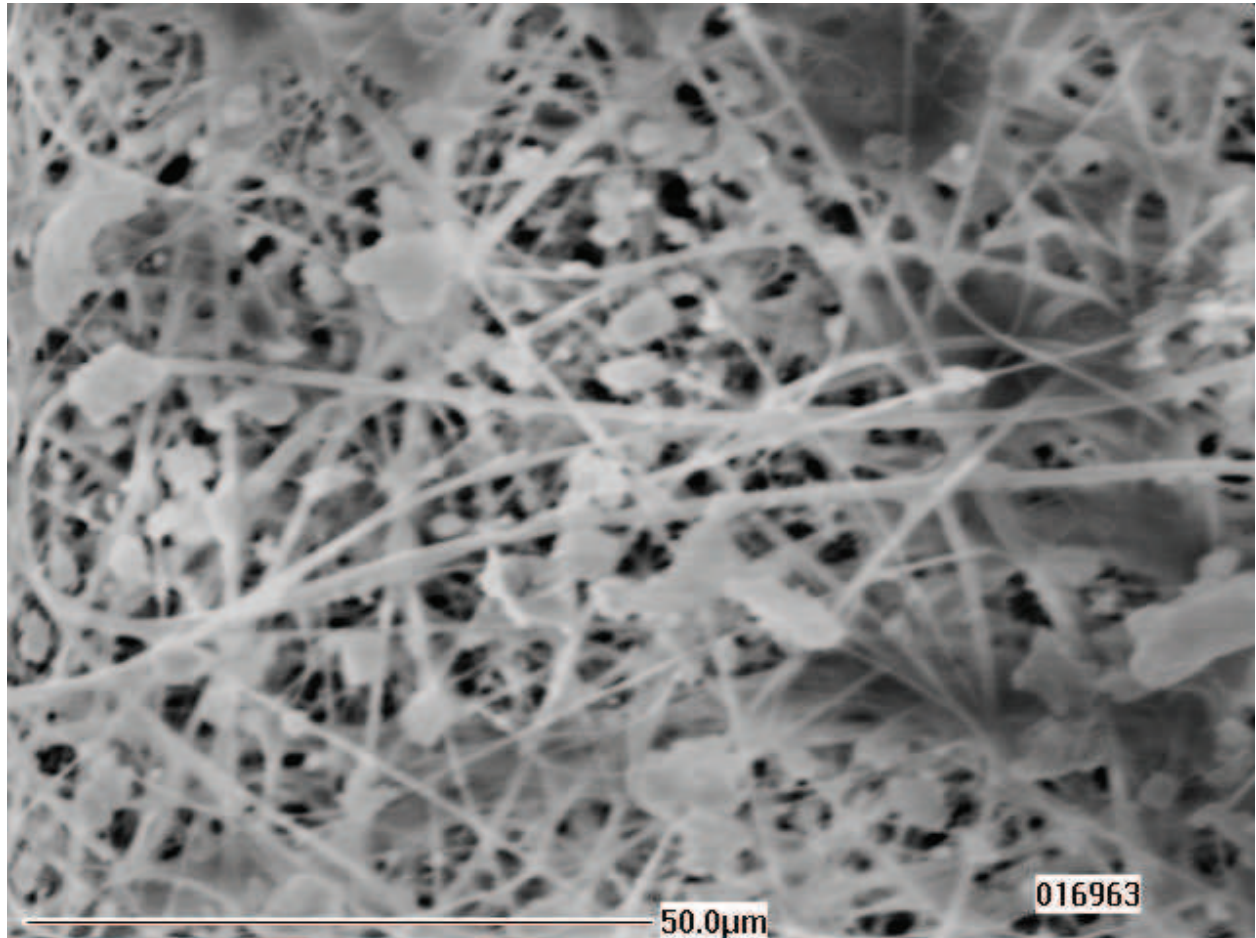
D A Cowper, SEM Senior Analyst
Direct Dial: 01283 554462

SEM-EDS Photomicrographs

Santon Partisol Monitoring Location

Filter ID 864

Date Sample Taken – 08/05/2009



OCCUPATIONAL HYGIENE & ENVIRONMENTAL MONITORING LABORATORY

RESULTS OF EXAMINATION BY SEM-EDS

Ms R McCollom	Report Number:	OHEM 02349/SEM/0001, Rev 0
Environmental Scientist	Job Number:	OHEM 02349
Wardell Armstrong LLP	Date Received:	19 April 2010
2 The Avenue	Date Analysed:	14 June 2010
Leigh	Sample Description:	PM10 GLA47mm Filter Ref ST2 968
WN7 1ES	TES Sample ID Number:	016964
	Issue Date:	18 June, 2010
	Page:	3 of 10

Identification of Dust Gauge / Environmental Deposits by SEM-EDS Method Number SEMDG7

Category	Section 1 Estimated %	Section 2 Estimated %	Section 3 Estimated %	Section 4 Estimated %	Section 5 Estimated %	Average Estimated %
Carbonaceous matter	28	25	25	23	18	24
Iron rich	7	10	5	10	7	8
Calcium rich	15	28	20	20	23	21
Aluminium/silicon/ calcium rich	13	7	8	18	20	13
Aluminium/silicon rich	2	2	*	*	*	1
Aluminium/silicon/ potassium rich	*	*	7	2	*	2
Silicon rich	15	15	10	10	15	13
Calcium/silicon rich	13	13	20	17	12	15
Animal/plant fragments	7	*	5	*	5	3

- 99% of particles present were <10µm in size.
- The examination procedure is based on an assessment of forty individual particles selected at random.
- The estimated percentage is based on a comparison of the relative number of particles counted in each category.
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Authorised by:



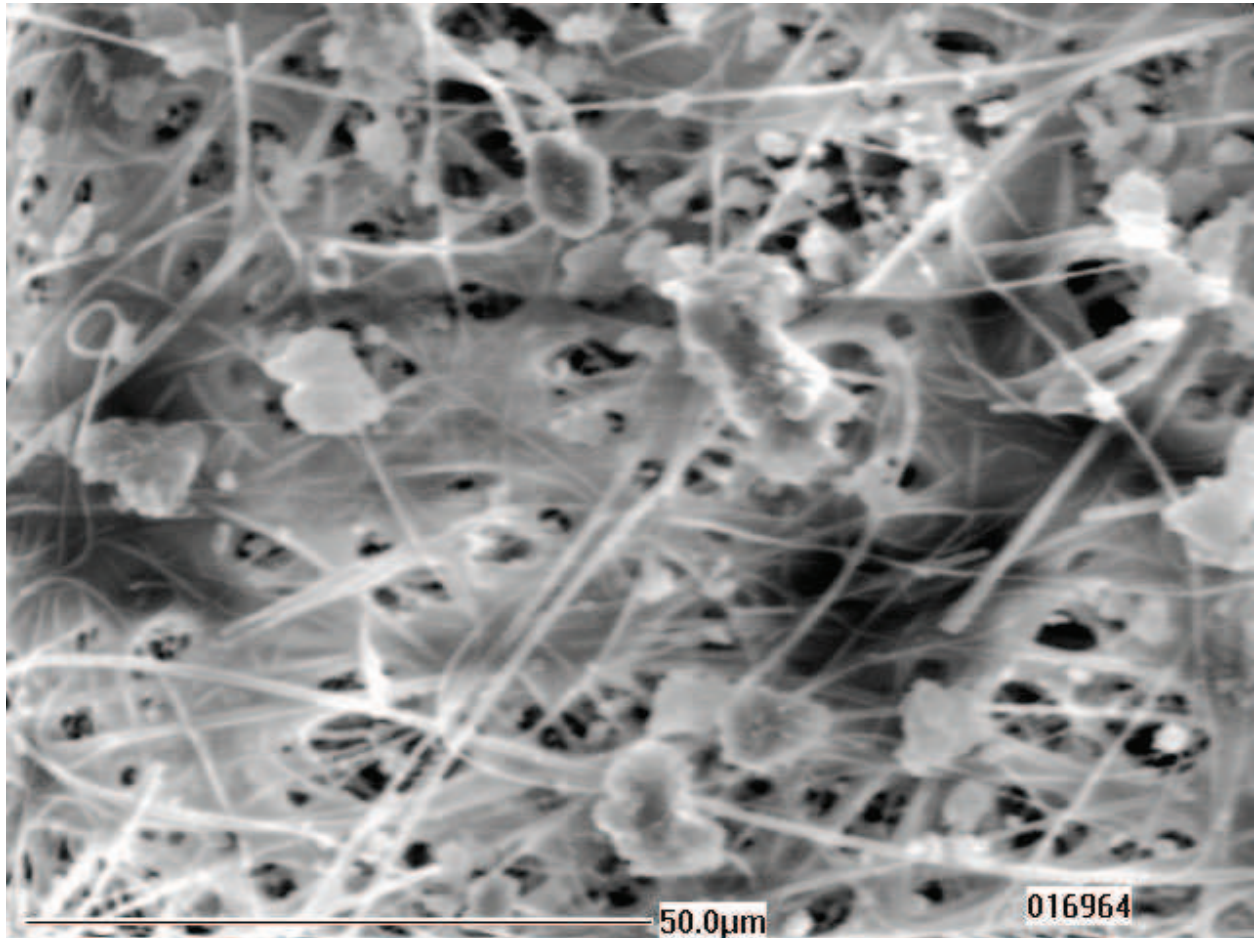
D A Cowper, SEM Senior Analyst
Direct Dial: 01283 554462

SEM-EDS Photomicrographs

Santon Partisol Monitoring Location

Filter ID 968

Date Sample Taken – 20/08/2009



OCCUPATIONAL HYGIENE & ENVIRONMENTAL MONITORING LABORATORY

RESULTS OF EXAMINATION BY SEM-EDS

Ms R McCollom	Report Number:	OHEM 02349/SEM/0001, Rev 0
Environmental Scientist	Job Number:	OHEM 02349
Wardell Armstrong LLP	Date Received:	19 April 2010
2 The Avenue	Date Analysed:	14 & 15 June 2010
Leigh	Sample Description:	PM10 GLA47mm Filter Ref ST2 999
WN7 1ES	TES Sample ID Number:	016965
	Issue Date:	18 June, 2010
	Page:	4 of 10

Identification of Dust Gauge / Environmental Deposits by SEM-EDS Method Number SEMDG7

Category	Section 1 Estimated %	Section 2 Estimated %	Section 3 Estimated %	Section 4 Estimated %	Section 5 Estimated %	Average Estimated %
Aluminium/silicon/ calcium rich	15	10	10	8	23	13
Carbonaceous matter	15	23	23	25	10	19
Iron rich	17	5	10	5	15	10
Calcium rich	23	17	20	30	25	23
Aluminium/silicon/ potassium rich	5	*	2	*	*	2
Calcium/silicon rich	15	18	20	15	10	16
Aluminium/silicon rich	*	7	*	5	*	2
Silicon rich	10	20	10	7	17	13
Sodium/chlorine rich	*	*	5	5	*	2

- 99% of particles present were <10µm in size.
- The examination procedure is based on an assessment of forty individual particles selected at random.
- The estimated percentage is based on a comparison of the relative number of particles counted in each category.
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Analysed &

Authorised by:



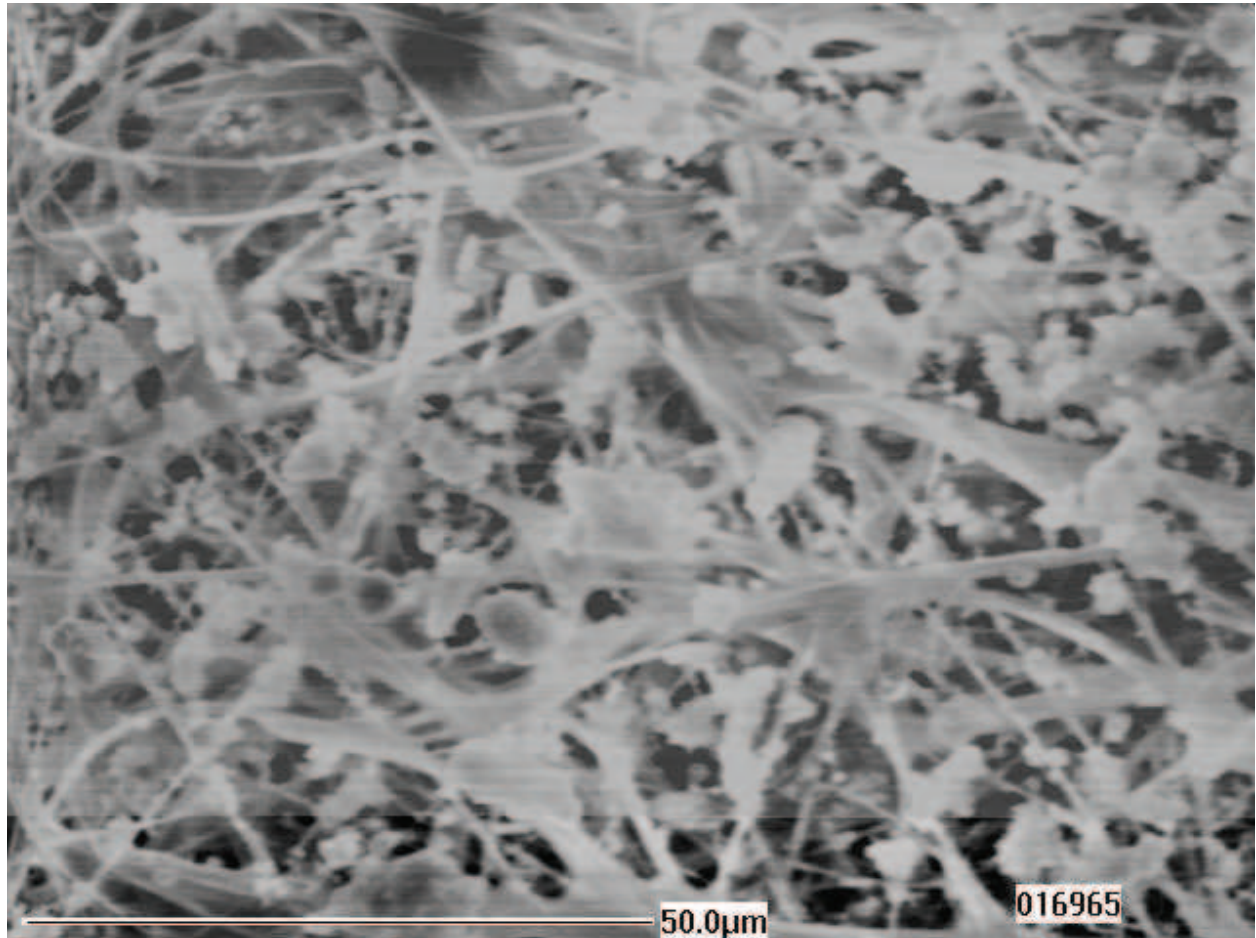
D A Cowper, SEM Senior Analyst
Direct Dial: 01283 554462

SEM-EDS Photomicrographs

Santon Partisol Monitoring Location

Filter ID 999

Date Sample Taken – 21/09/2009



OCCUPATIONAL HYGIENE & ENVIRONMENTAL MONITORING LABORATORY

RESULTS OF EXAMINATION BY SEM-EDS


Ms R McCollom	Report Number:	OHEM 02249/SEM/0001, Rev 0
Environmental Scientist	Job Number:	OHEM 02249
Wardell Armstrong LLP	Date Received:	06 April 2010
2 The Avenue	Date Analysed:	23 April 2010
Leigh	Sample Description:	PM10 GLA47mm Filter Ref ST2 1000
WN7 1ES	TES Sample ID Number:	016359
	Issue Date:	21 May, 2010
	Page:	9 of 10

Identification of Dust Gauge / Environmental Deposits by SEM-EDS Method Number SEMDG7

Category	Section 1 Estimated %	Section 2 Estimated %	Section 3 Estimated %	Section 4 Estimated %	Section 5 Estimated %	Average Estimated %
Calcium/sulphur rich	18	10	5	*	*	7
Carbonaceous matter	38	25	40	38	35	35
Iron rich	2	5	7	2	5	4
Calcium/aluminium/ silicon rich	12	13	13	18	5	12
Aluminium/silicon/ potassium rich	*	2	*	2	5	2
Silicon rich	15	10	10	5	10	10
Calcium rich	*	20	15	20	15	14
Aluminium/silicon rich	*	*	*	*	2	<1
Sodium/chlorine rich	5	*	*	5	2	2
Animal/plant fragment	2	*	*	*	8	2
Calcium/magnesium	*	*	*	10	*	2
Calcium/silicon rich	8	15	10	*	13	9

- 99% of particles present were <10µm in size.
- The examination procedure is based on an assessment of forty individual particles selected at random.
- The estimated percentage is based on a comparison of the relative number of particles counted in each category.
- TES Bretby does not accept responsibility for the sampling associated with the results reported above.
- Opinions and interpretations expressed herein are outside the scope of our UKAS accreditation.

Analysed by:


D Rayson, SEM Analyst

Analysed &
Authorised by:



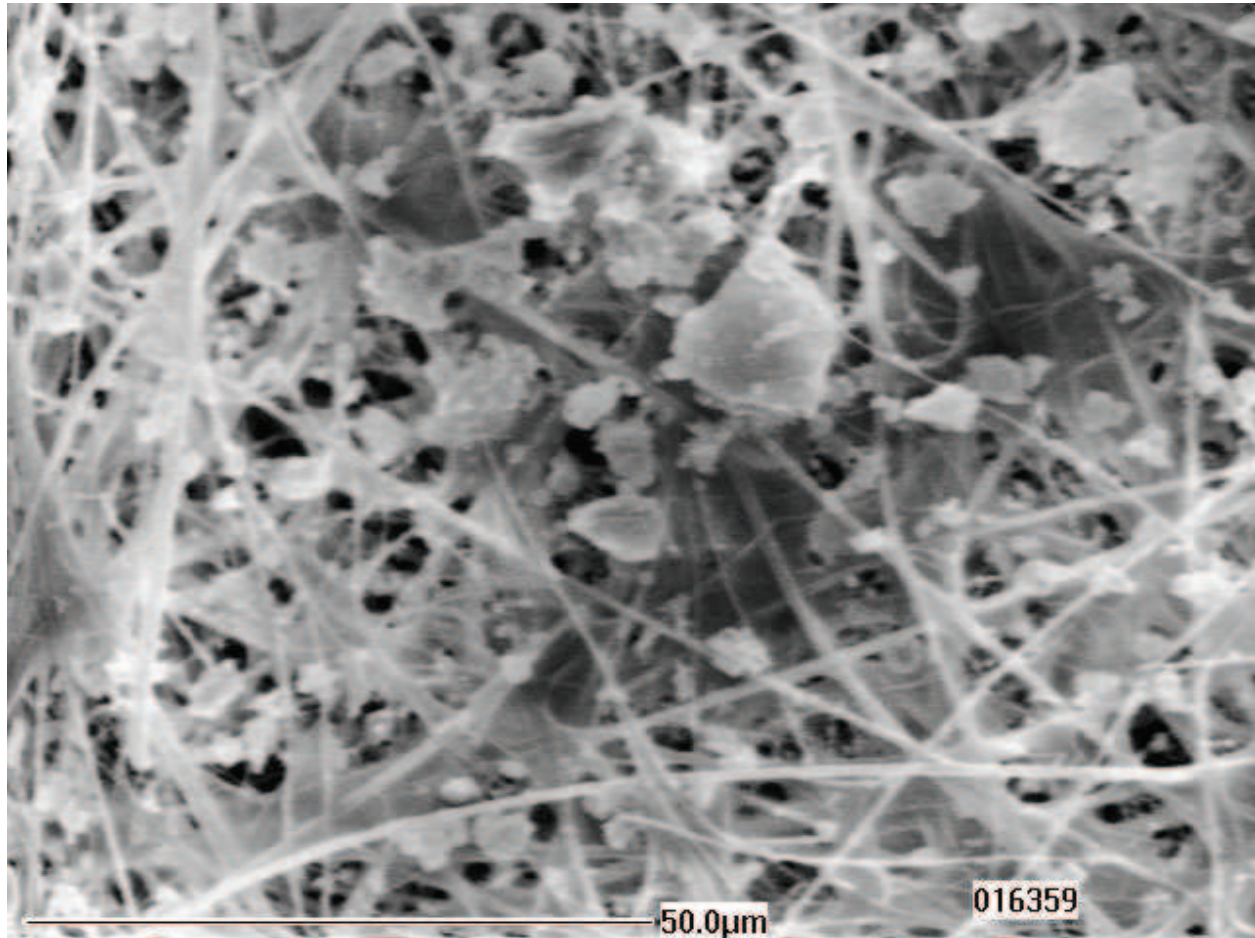
D A Cowper, SEM Senior Analyst
Direct Dial: 01283 554462

SEM-EDS Photomicrographs

Santon Partisol Monitoring Location

Filter ID 1000

Date Sample Taken – 22/09/2009



OCCUPATIONAL HYGIENE & ENVIRONMENTAL MONITORING LABORATORY

RESULTS OF EXAMINATION BY SEM-EDS


Ms R McCollom	Report Number:	OHEM 02249/SEM/0001, Rev 0
Environmental Scientist	Job Number:	OHEM 02249
Wardell Armstrong LLP	Date Received:	06 April 2010
2 The Avenue	Date Analysed:	22/23 April 2010
Leigh	Sample Description:	PM10 GLA47mm Filter Ref ST2 1046
WN7 1ES	TES Sample ID Number:	016358
	Issue Date:	21 May, 2010
	Page:	8 of 10

Identification of Dust Gauge / Environmental Deposits by SEM-EDS Method Number SEMDG7

Category	Section 1 Estimated %	Section 2 Estimated %	Section 3 Estimated %	Section 4 Estimated %	Section 5 Estimated %	Average Estimated %
Calcium/sulphur rich	25	22	15	10	18	18
Carbonaceous matter	38	38	40	30	38	37
Iron rich	2	*	15	10	10	7
Calcium/aluminium/ silicon rich	8	13	3	7	2	7
Aluminium/silicon/ potassium rich	5	5	*	5	*	3
Silicon rich	18	10	3	15	13	12
Calcium rich	*	*	2	*	7	2
Aluminium/silicon rich	*	7	*	*	5	2
Sodium/chlorine rich	2	5	20	13	5	9
Animal/plant fragment	2	*	2	*	2	1
Lead/chlorine rich	*	*	*	10	*	2

- 99% of particles present were <10µm in size.
- The examination procedure is based on an assessment of forty individual particles selected at random.
- The estimated percentage is based on a comparison of the relative number of particles counted in each category.
- TES Bretby does not accept responsibility for the sampling associated with the results reported above.
- Opinions and interpretations expressed herein are outside the scope of our UKAS accreditation.

Analysed by:


D Rayson, SEM Analyst

Analysed &
Authorised by:

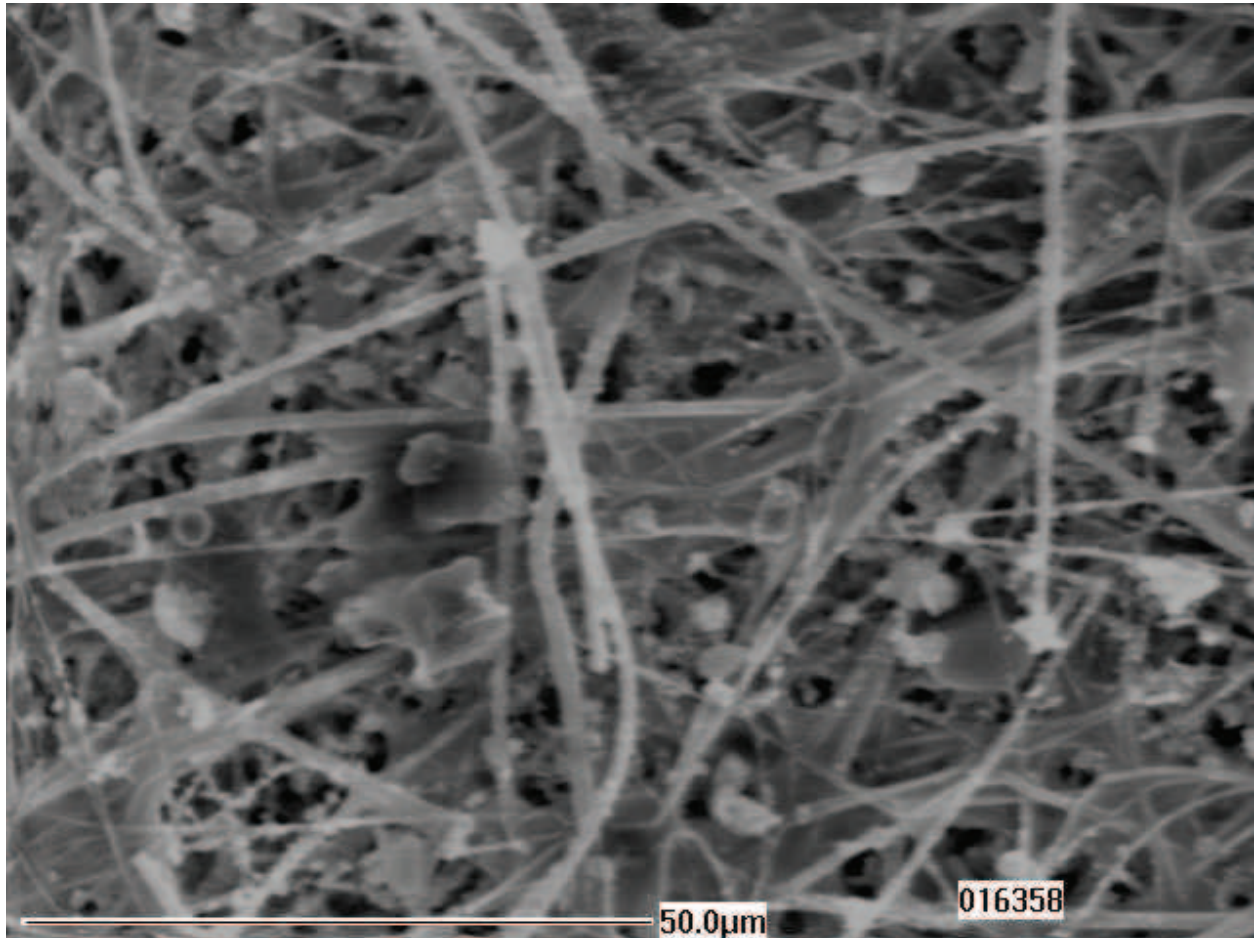

D A Cowper, SEM Senior Analyst
Direct Dial: 01283 554462

SEM-EDS Photomicrographs

Santon Partisol Monitoring Location

Filter ID 1046

Date Sample Taken – 06/11/2009



OCCUPATIONAL HYGIENE & ENVIRONMENTAL MONITORING LABORATORY

RESULTS OF EXAMINATION BY SEM-EDS

Ms R McCollom	Report Number:	OHEM 02349/SEM/0001, Rev 0
Environmental Scientist	Job Number:	OHEM 02349
Wardell Armstrong LLP	Date Received:	19 April 2010
2 The Avenue	Date Analysed:	15 June 2010
Leigh	Sample Description:	PM10 GLA47mm Filter Ref ST2 1151
WN7 1ES	TES Sample ID Number:	016966
	Issue Date:	18 June, 2010
	Page:	5 of 10

Identification of Dust Gauge / Environmental Deposits by SEM-EDS Method Number SEMDG7

Category	Section 1 Estimated %	Section 2 Estimated %	Section 3 Estimated %	Section 4 Estimated %	Section 5 Estimated %	Average Estimated %
Calcium/sulphur rich	18	13	7	5	*	9
Carbonaceous matter	10	5	*	*	5	4
Iron rich	5	5	*	20	*	6
Calcium/aluminium/ silicon rich	15	15	*	*	12	8
Aluminium/silicon/ potassium rich	10	5	13	12	23	13
Silicon rich	35	15	63	33	45	38
Aluminium/silicon rich	*	*	5	5	10	4
Calcium rich	*	2	*	10	*	2
Calcium/silicon rich	5	28	2	*	*	7
Animal/plant fragments	2	12	10	15	5	9

- 99% of particles present were <10µm in size.
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- The estimated percentage is based on a comparison of the relative number of particles counted in each category.
- TES Bretby does not accept responsibility for the sampling associated with the results reported above.
- Opinions and interpretations expressed herein are outside the scope of our UKAS accreditation.

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Authorised by:



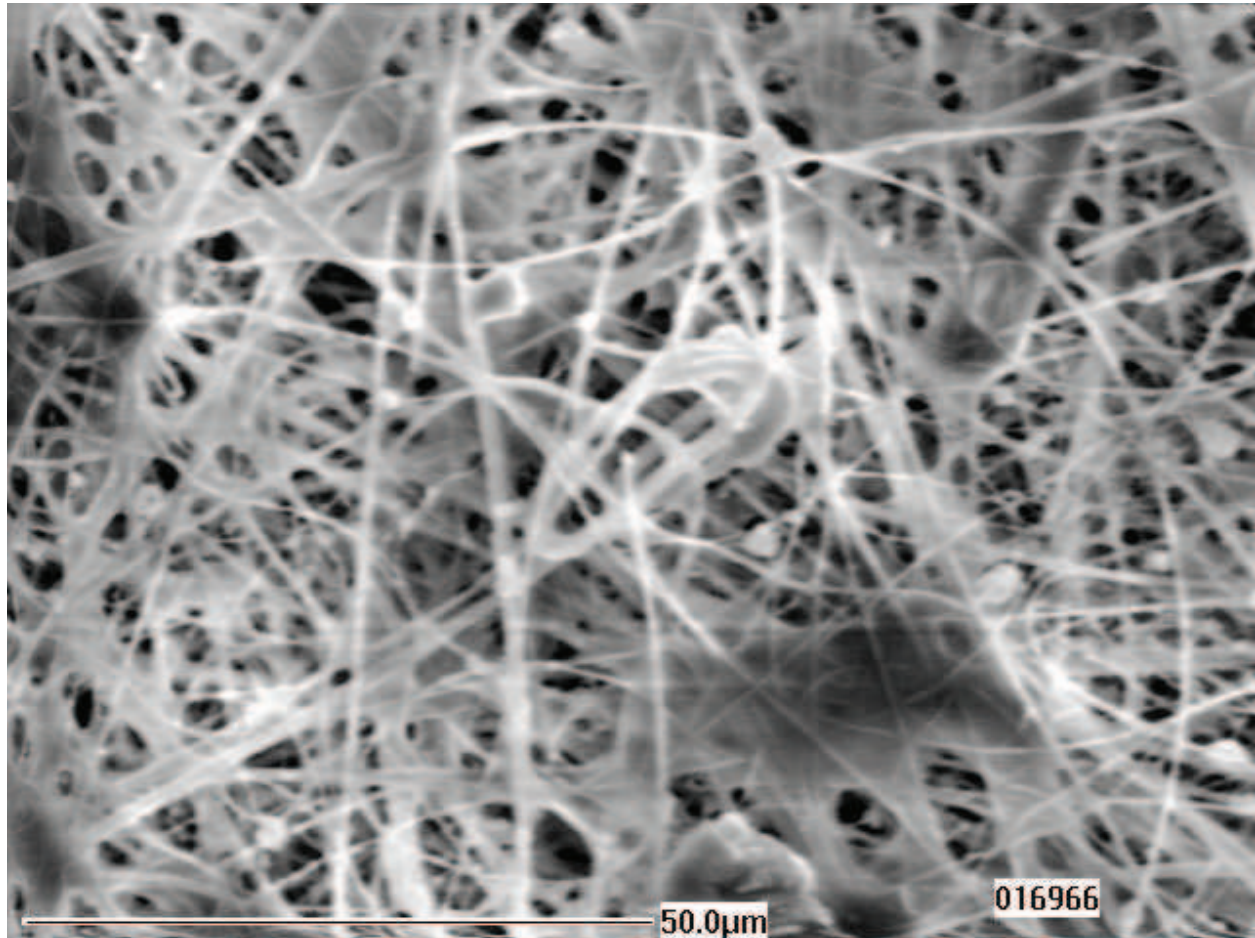
D A Cowper, SEM Senior Analyst
Direct Dial: 01283 554462

SEM-EDS Photomicrographs

Santon Partisol Monitoring Location

Filter ID 1151

Date Sample Taken – 18/02/2010



OCCUPATIONAL HYGIENE & ENVIRONMENTAL MONITORING LABORATORY

RESULTS OF EXAMINATION BY SEM-EDS

Ms R McCollom	Report Number:	OHEM 02349/SEM/0001, Rev 0
Environmental Scientist	Job Number:	OHEM 02349
Wardell Armstrong LLP	Date Received:	19 April 2010
2 The Avenue	Date Analysed:	16 & 17 June 2010
Leigh	Sample Description:	PM10 GLA47mm Filter Ref ST1 864
WN7 1ES	TES Sample ID Number:	016971
	Issue Date:	18 June, 2010
	Page:	10 of 10

Identification of Dust Gauge / Environmental Deposits by SEM-EDS Method Number SEMDG7

Category	Section 1 Estimated %	Section 2 Estimated %	Section 3 Estimated %	Section 4 Estimated %	Section 5 Estimated %	Average Estimated %
Calcium/sulphur rich	27	15	33	10	10	19
Carbonaceous matter	5	10	7	5	12	8
Calcium/aluminium/ silicon rich	*	5	10	5	*	4
Aluminium/potassium silicon rich	20	23	38	23	33	27
Silicon rich	48	30	12	40	30	32
Aluminium/silicon rich	*	5	*	10	5	4
Animal/plant fragment	*	12	*	7	10	6

- 99% of particles present were <10µm in size.
- The examination procedure is based on an assessment of forty individual particles selected at random.
- The estimated percentage is based on a comparison of the relative number of particles counted in each category.
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- Opinions and interpretations expressed herein are outside the scope of our UKAS accreditation.

Analysed &
Authorised by:



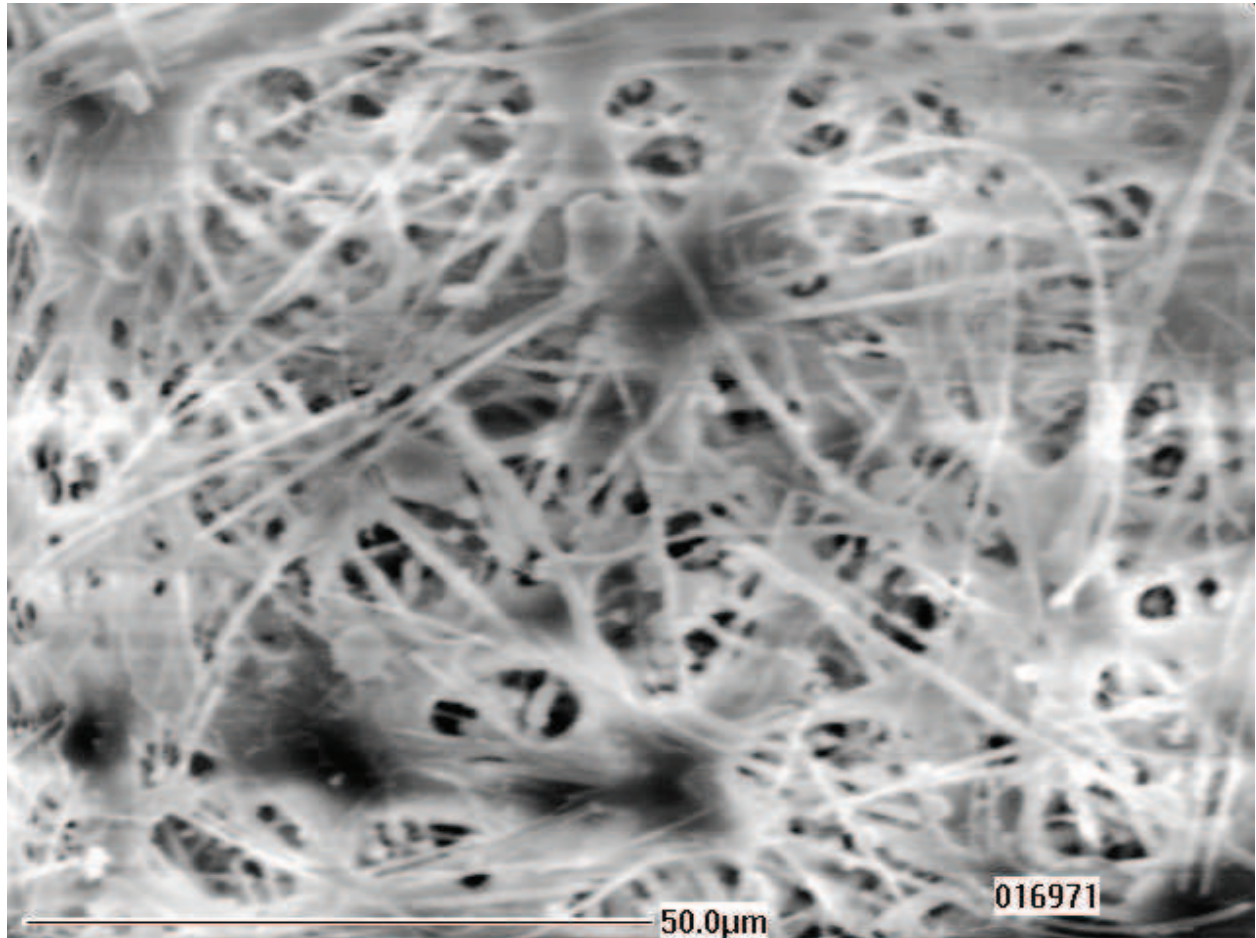
D A Cowper, SEM Senior Analyst
Direct Dial: 01283 554462

SEM-EDS Photomicrographs

Rowland Road Partisol Monitoring Location

Filter ID 864

Date Sample Taken – 01/01/2009



OCCUPATIONAL HYGIENE & ENVIRONMENTAL MONITORING LABORATORY

RESULTS OF EXAMINATION BY SEM-EDS

Ms R McCollom	Report Number:	OHEM 02349/SEM/0001, Rev 0
Environmental Scientist	Job Number:	OHEM 02349
Wardell Armstrong LLP	Date Received:	19 April 2010
2 The Avenue	Date Analysed:	15 June 2010
Leigh	Sample Description:	PM10 GLA47mm Filter Ref ST1 893
WN7 1ES	TES Sample ID Number:	016967
	Issue Date:	18 June, 2010
	Page:	6 of 10

Identification of Dust Gauge / Environmental Deposits by SEM-EDS Method Number SEMDG7

Category	Section 1 Estimated %	Section 2 Estimated %	Section 3 Estimated %	Section 4 Estimated %	Section 5 Estimated %	Average Estimated %
Calcium/sulphur rich	33	30	10	12	13	20
Carbonaceous matter	10	2	5	18	5	8
Iron rich	2	*	5	10	7	5
Calcium/aluminium/ silicon rich	23	23	15	18	8	17
Aluminium/silicon/ potassium rich	15	33	25	12	40	25
Silicon rich	17	12	25	15	20	18
Calcium /silicon rich	*	*	5	15	*	4
Animal/plant fragments	*	*	10	*	7	3

- 99% of particles present were <10µm in size.
- The examination procedure is based on an assessment of forty individual particles selected at random.
- The estimated percentage is based on a comparison of the relative number of particles counted in each category.
- TES Bretby does not accept responsibility for the sampling associated with the results reported above.
- Opinions and interpretations expressed herein are outside the scope of our UKAS accreditation.

Analysed &
Authorised by:



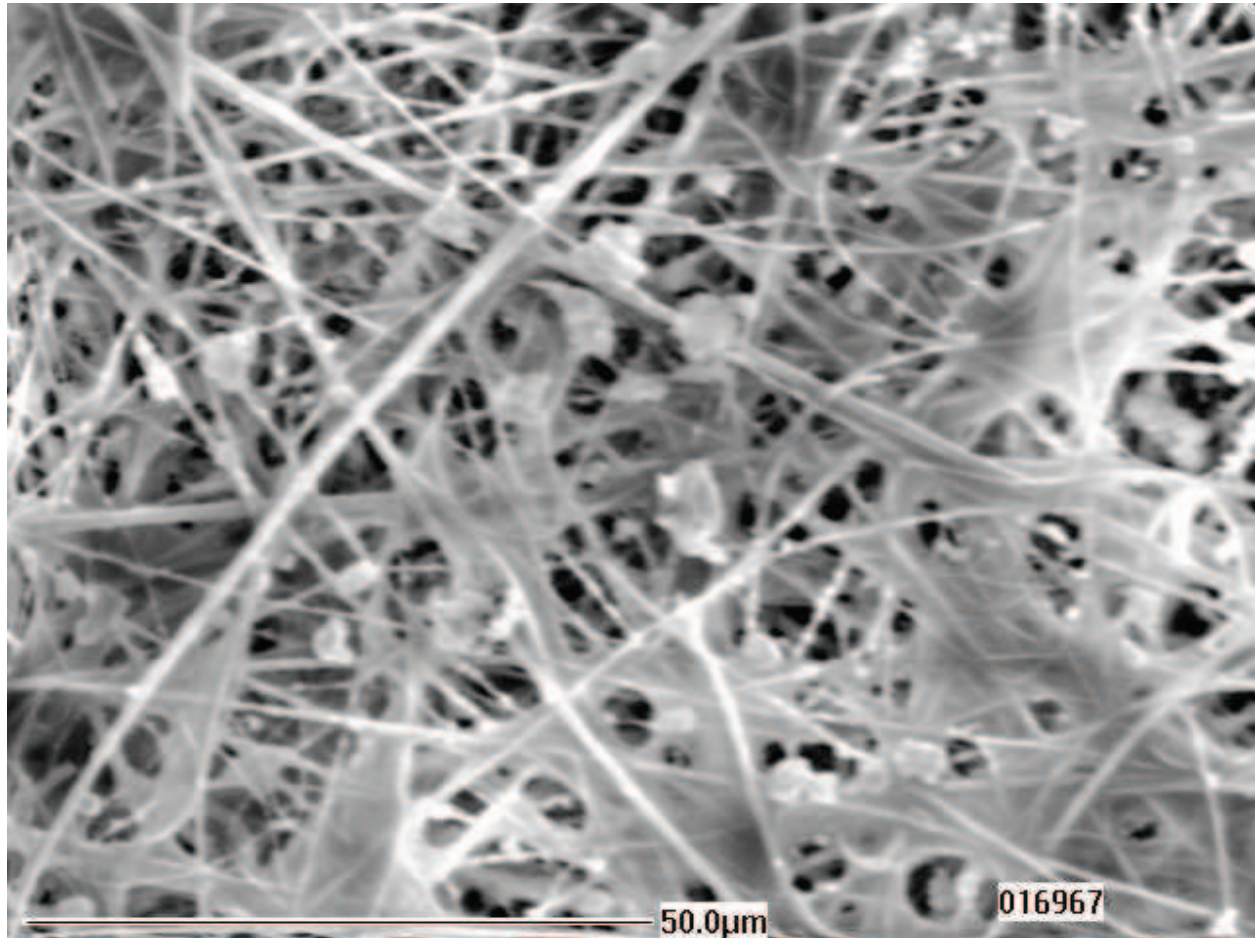
D A Cowper, SEM Senior Analyst
Direct Dial: 01283 554462

SEM-EDS Photomicrographs

Rowland Road Partisol Monitoring Location

Filter ID 893

Date Sample Taken – 30/01/2009



OCCUPATIONAL HYGIENE & ENVIRONMENTAL MONITORING LABORATORY

RESULTS OF EXAMINATION BY SEM-EDS


Ms R McCollom	Report Number:	OHEM 02249/SEM/0001, Rev 0
Environmental Scientist	Job Number:	OHEM 02249
Wardell Armstrong LLP	Date Received:	06 April 2010
2 The Avenue	Date Analysed:	16 April 2010
Leigh	Sample Description:	PM10 GLA47mm Filter Ref ST1 894
WN7 1ES	TES Sample ID Number:	016355
	Issue Date:	21 May, 2010
	Page:	5 of 10

Identification of Dust Gauge / Environmental Deposits by SEM-EDS Method Number SEMDG7

Category	Section 1 Estimated %	Section 2 Estimated %	Section 3 Estimated %	Section 4 Estimated %	Section 5 Estimated %	Average Estimated %
Calcium/sulphur rich	13	15	15	2	12	11
Carbonaceous matter	18	45	23	35	38	32
Iron rich	48	7	15	13	10	19
Calcium/aluminium/ silicon rich	*	13	12	10	5	8
Aluminium/silicon/ potassium rich	*	*	2	7	*	2
Silicon rich	*	5	13	8	18	9
Aluminium rich	5	*	*	*	*	1
Magnesium/sulphur rich	5	13	8	25	10	12
Aluminium/silicon rich	2	*	10	*	7	4
Calcium/chlorine rich	2	*	*	*	*	<1
Sodium/chlorine rich	2	*	*	*	*	<1
Calcium/magnesium rich	*	*	2	*	*	<1
Magnesium/silicon rich	*	2	*	*	*	<1
Animal/plant fragments	5	*	*	*	*	1

- 99% of particles present were <10µm in size.
- The examination procedure is based on an assessment of forty individual particles selected at random.
- The estimated percentage is based on a comparison of the relative number of particles counted in each category.
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- Opinions and interpretations expressed herein are outside the scope of our UKAS accreditation.

Analysed by:


D Rayson, SEM Analyst

Analysed &
Authorised by:

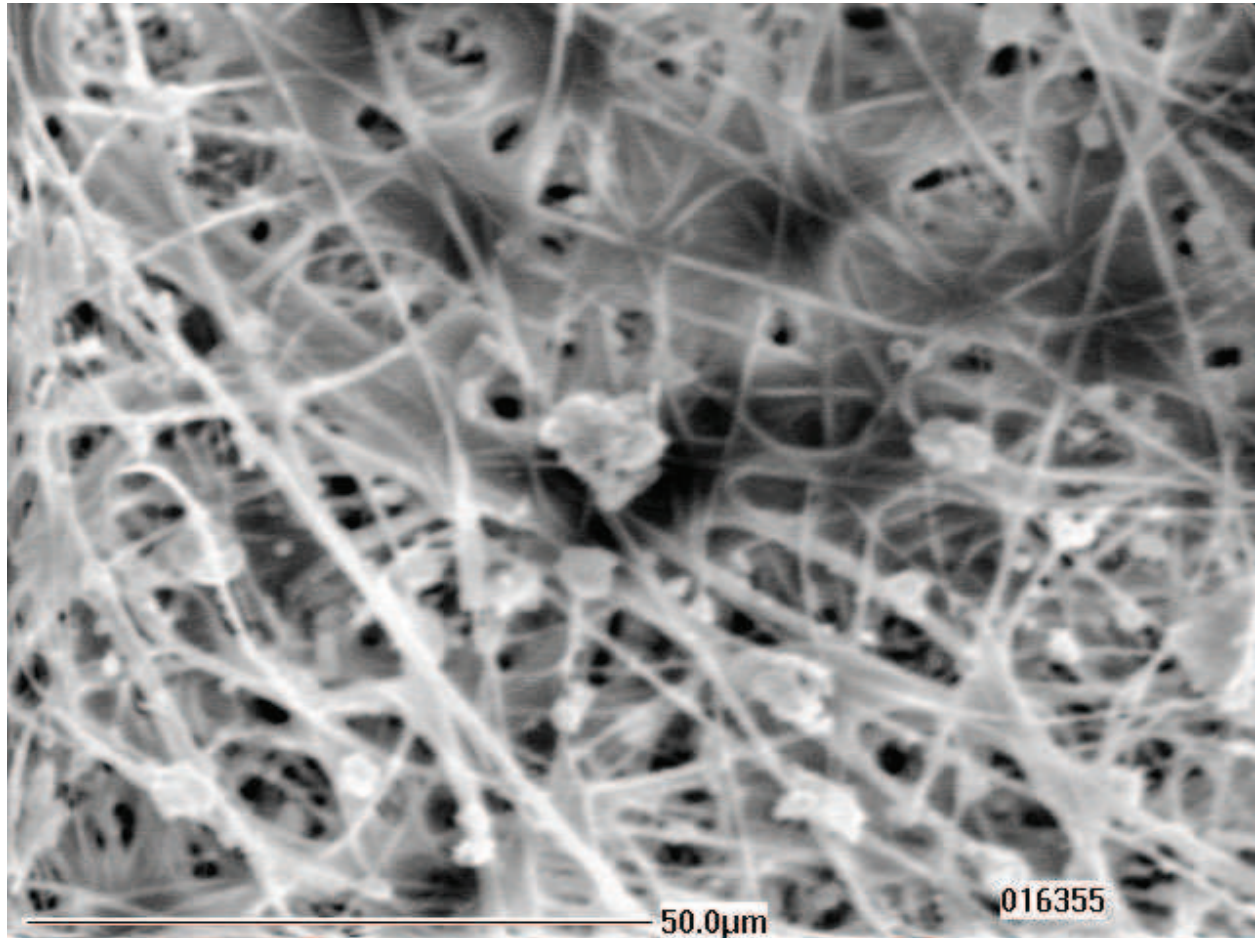

D A Cowper, SEM Senior Analyst
Direct Dial: 01283 554462

SEM-EDS Photomicrographs

Rowland Road Partisol Monitoring Location

Filter ID 894

Date Sample Taken – 31/01/2009



OCCUPATIONAL HYGIENE & ENVIRONMENTAL MONITORING LABORATORY

RESULTS OF EXAMINATION BY SEM-EDS

Ms R McCollom	Report Number:	OHEM 02349/SEM/0001, Rev 0
Environmental Scientist	Job Number:	OHEM 02349
Wardell Armstrong LLP	Date Received:	19 April 2010
2 The Avenue	Date Analysed:	16 June 2010
Leigh	Sample Description:	PM10 GLA47mm Filter Ref ST1 940
WN7 1ES	TES Sample ID Number:	016970
	Issue Date:	18 June, 2010
	Page:	9 of 10

Identification of Dust Gauge / Environmental Deposits by SEM-EDS Method Number SEMDG7

Category	Section 1 Estimated %	Section 2 Estimated %	Section 3 Estimated %	Section 4 Estimated %	Section 5 Estimated %	Average Estimated %
Calcium/sulphur rich	33	35	38	23	33	32
Carbonaceous matter	2	*	5	*	*	1
Iron rich	*	2	*	*	7	2
Calcium/aluminium/ silicon rich	18	15	5	20	5	13
Aluminium/silicon/ potassium rich	23	30	33	25	25	27
Silicon rich	17	10	12	25	15	16
Calcium rich	*	8	*	*	8	3
Aluminium/silicon rich	5	*	5	5	7	4
Animal/plant fragment	2	*	2	2	*	1

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- The examination procedure is based on an assessment of forty individual particles selected at random.
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- TES Bretby does not accept responsibility for the sampling associated with the results reported above.
- Opinions and interpretations expressed herein are outside the scope of our UKAS accreditation.

Analysed &
Authorised by:



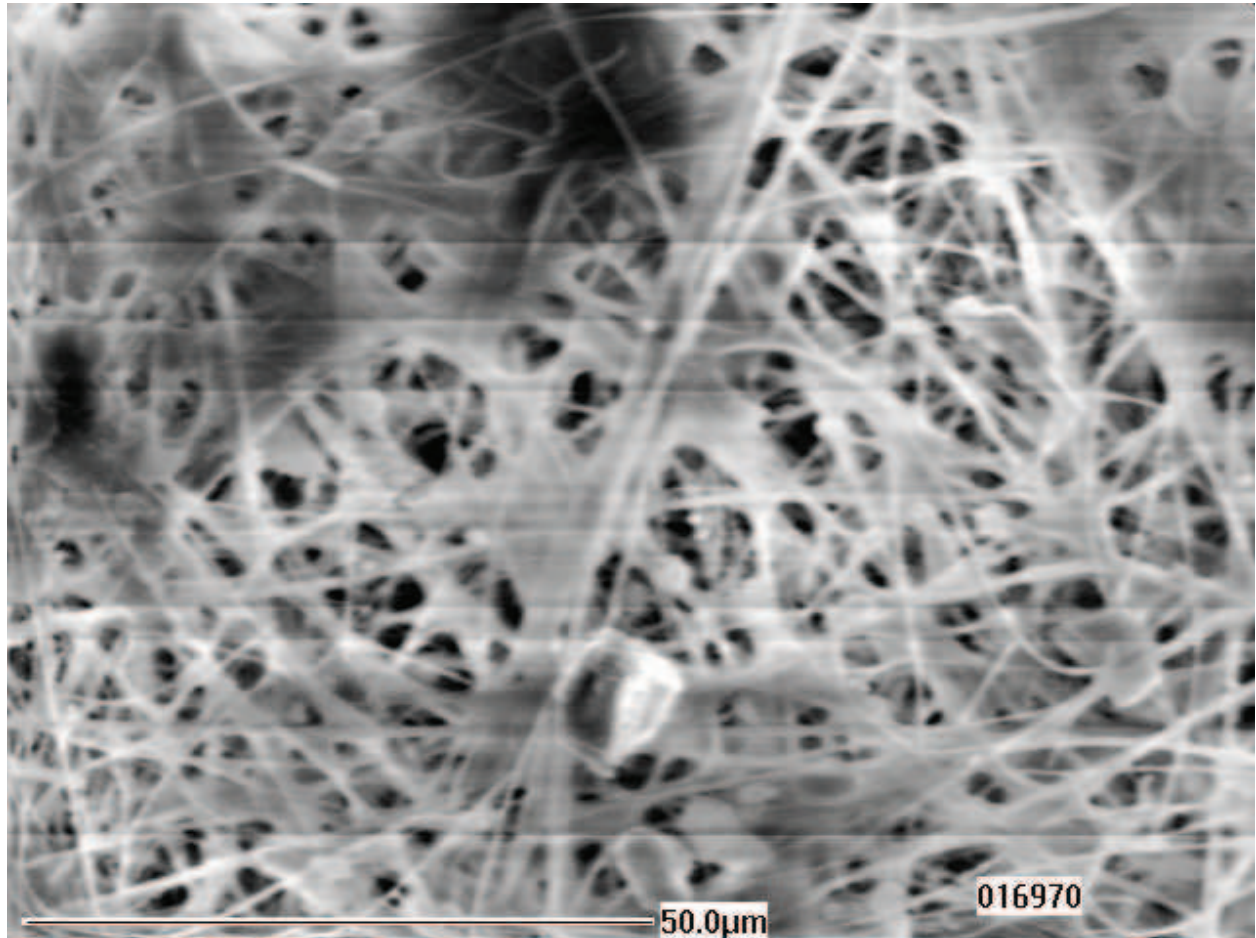
D A Cowper, SEM Senior Analyst
Direct Dial: 01283 554462

SEM-EDS Photomicrographs

Rowland Road Partisol Monitoring Location

Filter ID 940

Date Sample Taken – 18/03/2009



OCCUPATIONAL HYGIENE & ENVIRONMENTAL MONITORING LABORATORY

RESULTS OF EXAMINATION BY SEM-EDS

Ms R McCollom	Report Number:	OHEM 02249/SEM/0001, Rev 0
Environmental Scientist	Job Number:	OHEM 02249
Wardell Armstrong LLP	Date Received:	06 April 2010
2 The Avenue	Date Analysed:	14 April 2010
Leigh	Sample Description:	PM10 GLA47mm Filter Ref ST1 941
WN7 1ES	TES Sample ID Number:	016351
	Issue Date:	21 May, 2010
	Page:	1 of 10

Identification of Dust Gauge / Environmental Deposits by SEM-EDS Method Number SEMDG7

Category	Section 1 Estimated %	Section 2 Estimated %	Section 3 Estimated %	Section 4 Estimated %	Section 5 Estimated %	Average Estimated %
Calcium/sulphur rich	30	35	40	55	50	42
Carbonaceous matter	18	28	20	10	15	18
Iron rich	20	10	13	18	18	16
Magnesium/sulphur rich	13	5	*	3	5	5
Aluminium/silicon/ calcium rich	5	*	*	2	*	1
Aluminium/silicon/ potassium rich	10	*	13	*	5	6
Calcium/magnesium rich	2	*	5	*	*	1
Aluminium/silicon rich	2	5	*	*	*	1
Aluminium/silicon/ calcium/magnesium rich	*	5	*	*	*	1
Aluminium/silicon/ potassium/magnesium rich	*	*	5	*	*	1
Iron/sulphur rich	*	*	2	*	*	<1
Aluminium/silicon/ potassium/iron rich	*	12	*	5	*	3
Aluminium/silicon/ magnesium/iron rich	*	*	*	2	*	<1
Silicon rich	*	*	2	5	5	2
Sodium rich	*	*	*	*	2	<1

- 99% of particles present were <10µm in size.
- The examination procedure is based on an assessment of forty individual particles selected at random.
- The estimated percentage is based on a comparison of the relative number of particles counted in each category.
- TES Bretby does not accept responsibility for the sampling associated with the results reported above.
- Opinions and interpretations expressed herein are outside the scope of our UKAS accreditation.

Analysed by: 
D Rayson, SEM Analyst

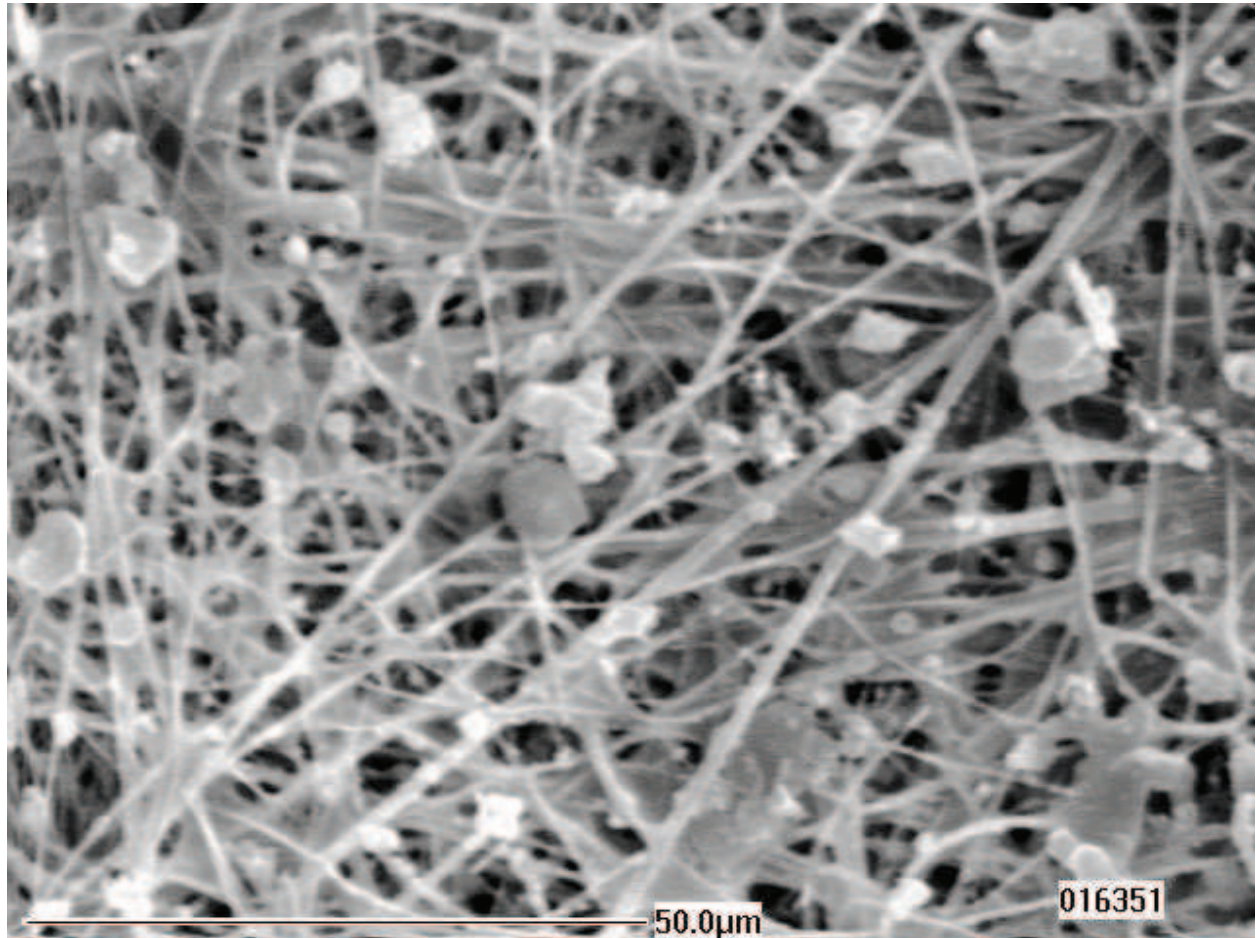
Authorised by: 
D A Cowper, SEM Senior Analyst
Direct Dial: 01 283 554462

SEM-EDS Photomicrographs

Rowland Road Partisol Monitoring Location

Filter ID 941

Date Sample Taken – 19/03/2009



OCCUPATIONAL HYGIENE & ENVIRONMENTAL MONITORING LABORATORY

RESULTS OF EXAMINATION BY SEM-EDS


Ms R McCollom	Report Number:	OHEM 02249/SEM/0001, Rev 0
Environmental Scientist	Job Number:	OHEM 02249
Wardell Armstrong LLP	Date Received:	06 April 2010
2 The Avenue	Date Analysed:	15/16 April 2010
Leigh	Sample Description:	PM10 GLA47mm Filter Ref ST1 1145
WN7 1ES	TES Sample ID Number:	016352
	Issue Date:	21 May, 2010
	Page:	2 of 10

Identification of Dust Gauge / Environmental Deposits by SEM-EDS Method Number SEMDG7

Category	Section 1 Estimated %	Section 2 Estimated %	Section 3 Estimated %	Section 4 Estimated %	Section 5 Estimated %	Average Estimated %
Calcium/sulphur rich	10	7	2	10	5	7
Carbonaceous matter	10	18	38	23	35	25
Iron rich	22	23	20	20	13	20
Calcium rich	23	7	13	12	10	13
Aluminium/silicon/ calcium rich	*	*	13	10	7	6
Aluminium/silicon/ potassium rich	*	5	*	*	*	1
Calcium/magnesium rich	10	23	*	*	*	7
Aluminium/silicon rich	*	*	*	*	8	2
Magnesium/silicon rich	*	*	2	*	2	<1
Silicon rich	*	5	5	20	20	10
Sodium rich	15	8	*	*	*	5
Sodium/chlorine rich	10	2	5	5	*	4
Sodium/chlorine/calcium/ sulphur rich	*	2	*	*	*	<1
Animal/plant fragments	*	*	2	*	*	<1

- 99% of particles present were <10µm in size.
- The examination procedure is based on an assessment of forty individual particles selected at random.
- The estimated percentage is based on a comparison of the relative number of particles counted in each category.
- TES Bretby does not accept responsibility for the sampling associated with the results reported above.
- Opinions and interpretations expressed herein are outside the scope of our UKAS accreditation.

Analysed by:


D Rayson, SEM Analyst

Analysed &
Authorised by:

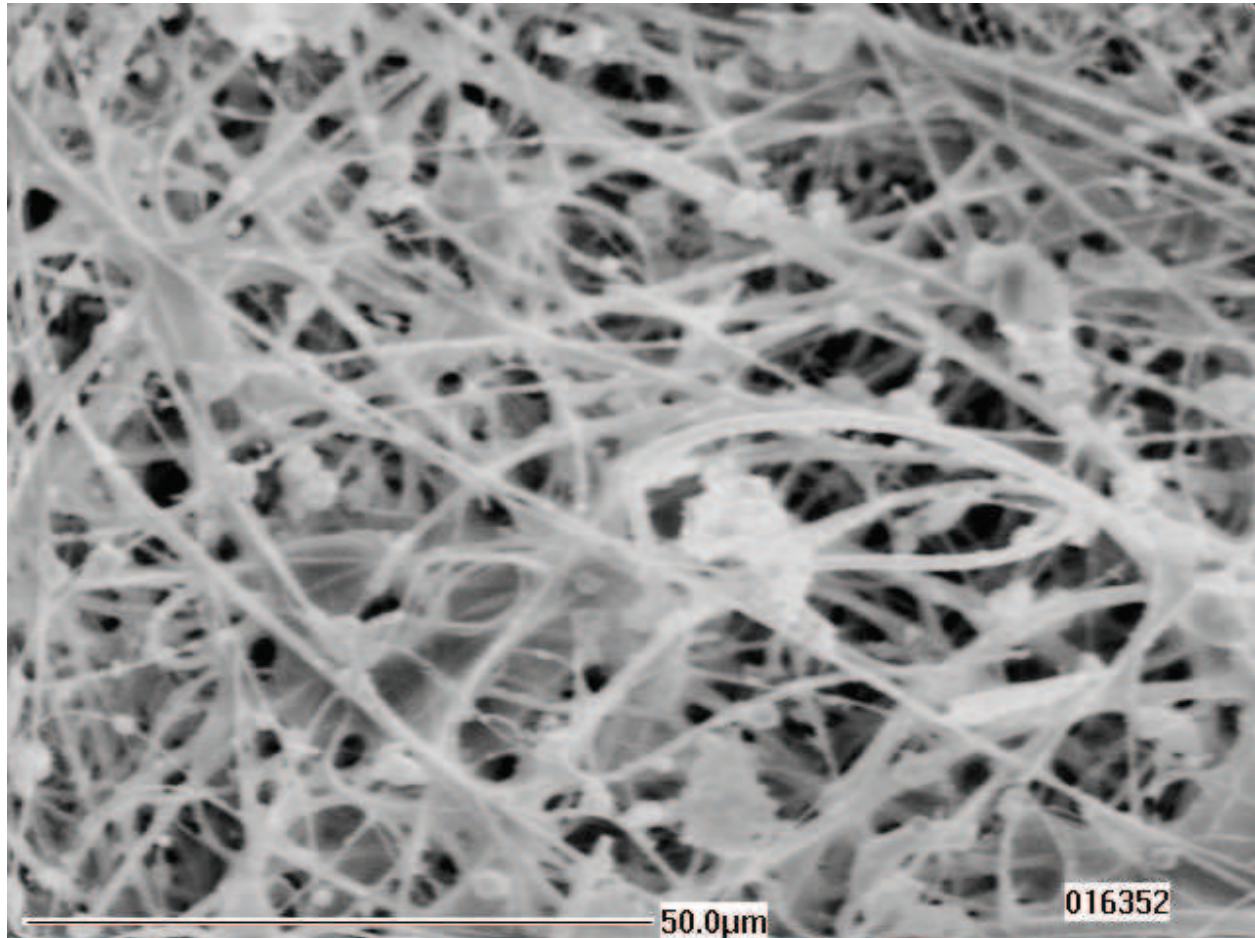

D A Cowper, SEM Senior Analyst
Direct Dial: 01283 554462

SEM-EDS Photomicrographs

Rowland Road Partisol Monitoring Location

Filter ID 1145

Date Sample Taken – 09/10/2009



OCCUPATIONAL HYGIENE & ENVIRONMENTAL MONITORING LABORATORY

RESULTS OF EXAMINATION BY SEM-EDS

Ms R McCollom	Report Number:	OHEM 02249/SEM/0001, Rev 0
Environmental Scientist	Job Number:	OHEM 02249
Wardell Armstrong LLP	Date Received:	06 April 2010
2 The Avenue	Date Analysed:	16 April 2010
Leigh	Sample Description:	PM10 GLA47mm Filter Ref ST1 1173
WN7 1ES	TES Sample ID Number:	016353
	Issue Date:	21 May, 2010
	Page:	3 of 10

Identification of Dust Gauge / Environmental Deposits by SEM-EDS Method Number SEMDG7

Category	Section 1 Estimated %	Section 2 Estimated %	Section 3 Estimated %	Section 4 Estimated %	Section 5 Estimated %	Average Estimated %
Calcium/sulphur rich	13	10	18	15	10	13
Carbonaceous matter	33	5	10	30	45	25
Iron rich	5	2	*	10	5	4
Calcium rich	2	*	*	*	*	<1
Aluminium/silicon/ potassium rich	*	10	12	5	10	7
Aluminium/silicon rich	*	5	2	*	5	3
Magnesium/silicon rich	5	7	5	5	*	4
Silicon rich	35	53	43	33	18	36
Chlorine rich	5	*	5	*	*	2
Sodium/chlorine rich	*	*	*	*	7	1
Calcium/silicon rich	*	*	5	*	*	1
Animal/plant fragments	2	8	*	2	*	2

- 99% of particles present were <10µm in size.
- The examination procedure is based on an assessment of forty individual particles selected at random.
- The estimated percentage is based on a comparison of the relative number of particles counted in each category.
- TES Bretby does not accept responsibility for the sampling associated with the results reported above.
- Opinions and interpretations expressed herein are outside the scope of our UKAS accreditation.

Analysed &
Authorised by:



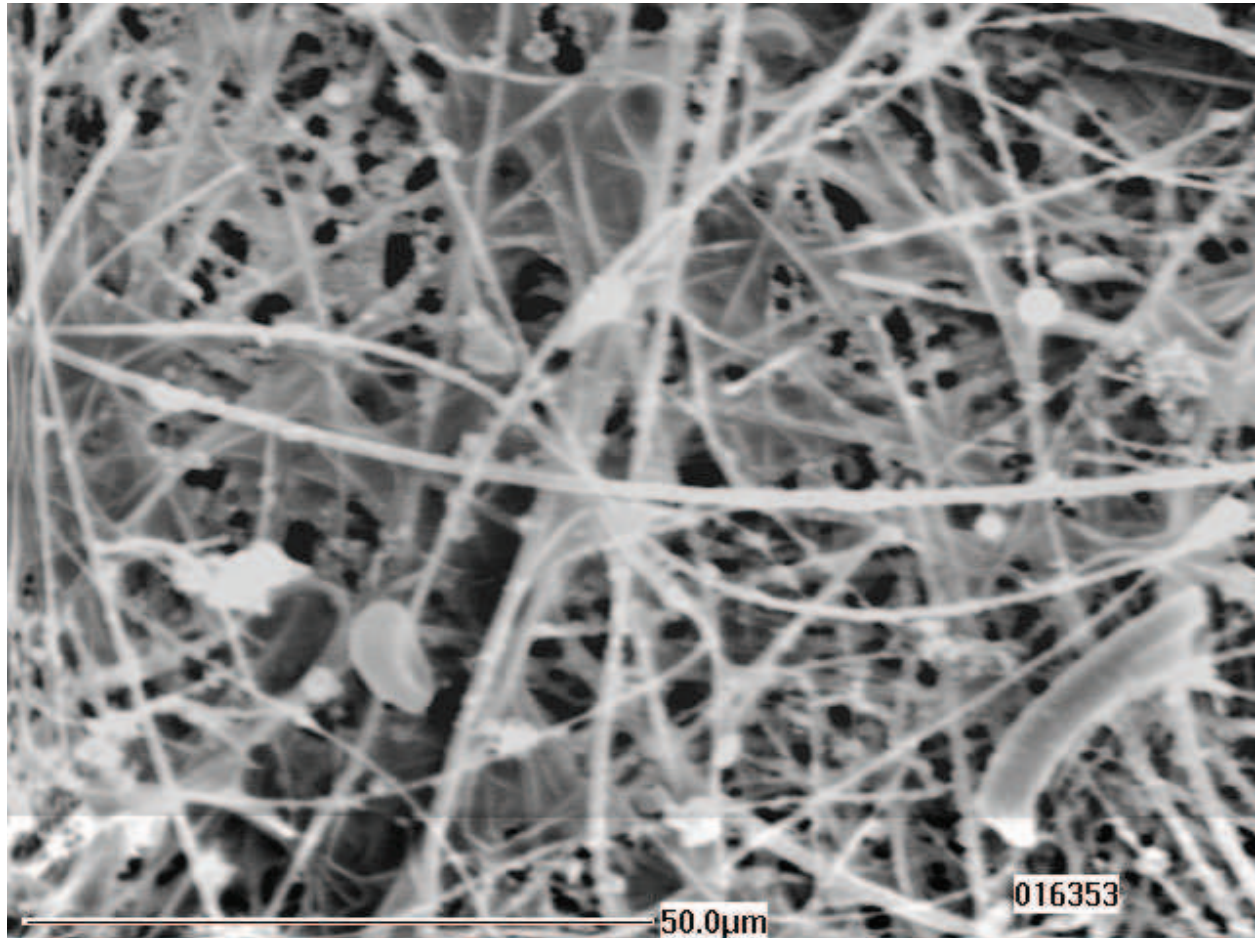
D A Cowper, SEM Senior Analyst
Direct Dial: 01283 554462

SEM-EDS Photomicrographs

Rowland Road Partisol Monitoring Location

Filter ID 1173

Date Sample Taken – 06/11/2009



OCCUPATIONAL HYGIENE & ENVIRONMENTAL MONITORING LABORATORY

RESULTS OF EXAMINATION BY SEM-EDS

Ms R McCollom	Report Number:	OHEM 02249/SEM/0001, Rev 0
Environmental Scientist	Job Number:	OHEM 02249
Wardell Armstrong LLP	Date Received:	06 April 2010
2 The Avenue	Date Analysed:	19 April 2010
Leigh	Sample Description:	PM10 GLA47mm Filter Ref ST1 1241
WN7 1ES	TES Sample ID Number:	016354
	Issue Date:	21 May, 2010
	Page:	4 of 10

Identification of Dust Gauge / Environmental Deposits by SEM-EDS Method Number SEMDG7

Category	Section 1 Estimated %	Section 2 Estimated %	Section 3 Estimated %	Section 4 Estimated %	Section 5 Estimated %	Average Estimated %
Calcium/sulphur rich	8	13	8	13	28	14
Carbonaceous matter	45	50	48	50	25	44
Iron rich	2	10	10	*	13	7
Calcium rich	7	*	*	*	*	1
Aluminium/silicon/ potassium rich	7	5	*	10	2	5
Aluminium/silicon rich	8	*	2	*	2	2
Magnesium/sulphur rich	*	*	10	12	15	7
Silicon rich	23	20	17	10	10	16
Animal/plant fragments	*	2	5	5	5	3

- 99% of particles present were <10µm in size.
- The examination procedure is based on an assessment of forty individual particles selected at random.
- The estimated percentage is based on a comparison of the relative number of particles counted in each category.
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- Opinions and interpretations expressed herein are outside the scope of our UKAS accreditation.

Analysed by:



D Rayson, SEM Analyst

Analysed &
Authorised by:



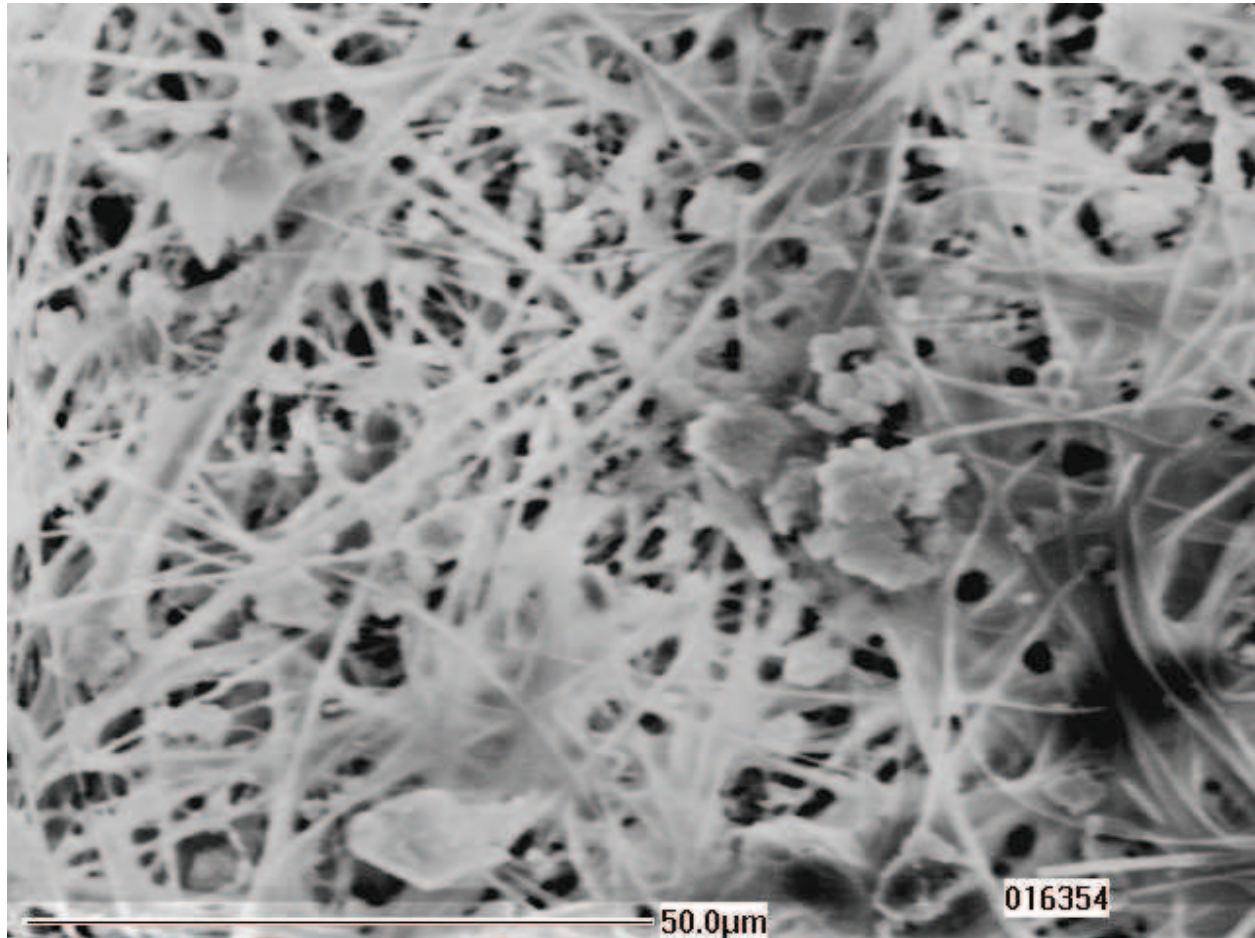
D A Cowper, SEM Senior Analyst
Direct Dial: 01283 554462

SEM-EDS Photomicrographs

Rowland Road Partisol Monitoring Location

Filter ID 1241

Date Sample Taken – 13/01/2010



OCCUPATIONAL HYGIENE & ENVIRONMENTAL MONITORING LABORATORY

RESULTS OF EXAMINATION BY SEM-EDS

Ms R McCollom	Report Number:	OHEM 02349/SEM/0001, Rev 0
Environmental Scientist	Job Number:	OHEM 02349
Wardell Armstrong LLP	Date Received:	19 April 2010
2 The Avenue	Date Analysed:	16 June 2010
Leigh	Sample Description:	PM10 GLA47mm Filter Ref ST1 1242
WN7 1ES	TES Sample ID Number:	016969
	Issue Date:	18 June, 2010
	Page:	8 of 10

Identification of Dust Gauge / Environmental Deposits by SEM-EDS Method Number SEMDG7

Category	Section 1 Estimated %	Section 2 Estimated %	Section 3 Estimated %	Section 4 Estimated %	Section 5 Estimated %	Average Estimated %
Calcium/sulphur rich	15	28	35	17	8	21
Carbonaceous matter	*	5	2	5	20	6
Iron rich	*	5	*	5	5	3
Calcium/aluminium/ silicon rich	*	*	*	5	7	2
Aluminium/silicon/ potassium rich	20	17	5	23	15	16
Silicon rich	53	43	43	38	45	44
Calcium rich	*	*	5	*	*	1
Aluminium/silicon rich	5	2	10	*	*	3
Animal/plant fragment	7	*	*	7	*	3

- 99% of particles present were <10µm in size.
- The examination procedure is based on an assessment of forty individual particles selected at random.
- The estimated percentage is based on a comparison of the relative number of particles counted in each category.
- TES Bretby does not accept responsibility for the sampling associated with the results reported above.
- Opinions and interpretations expressed herein are outside the scope of our UKAS accreditation.

Analysed &
Authorised by:



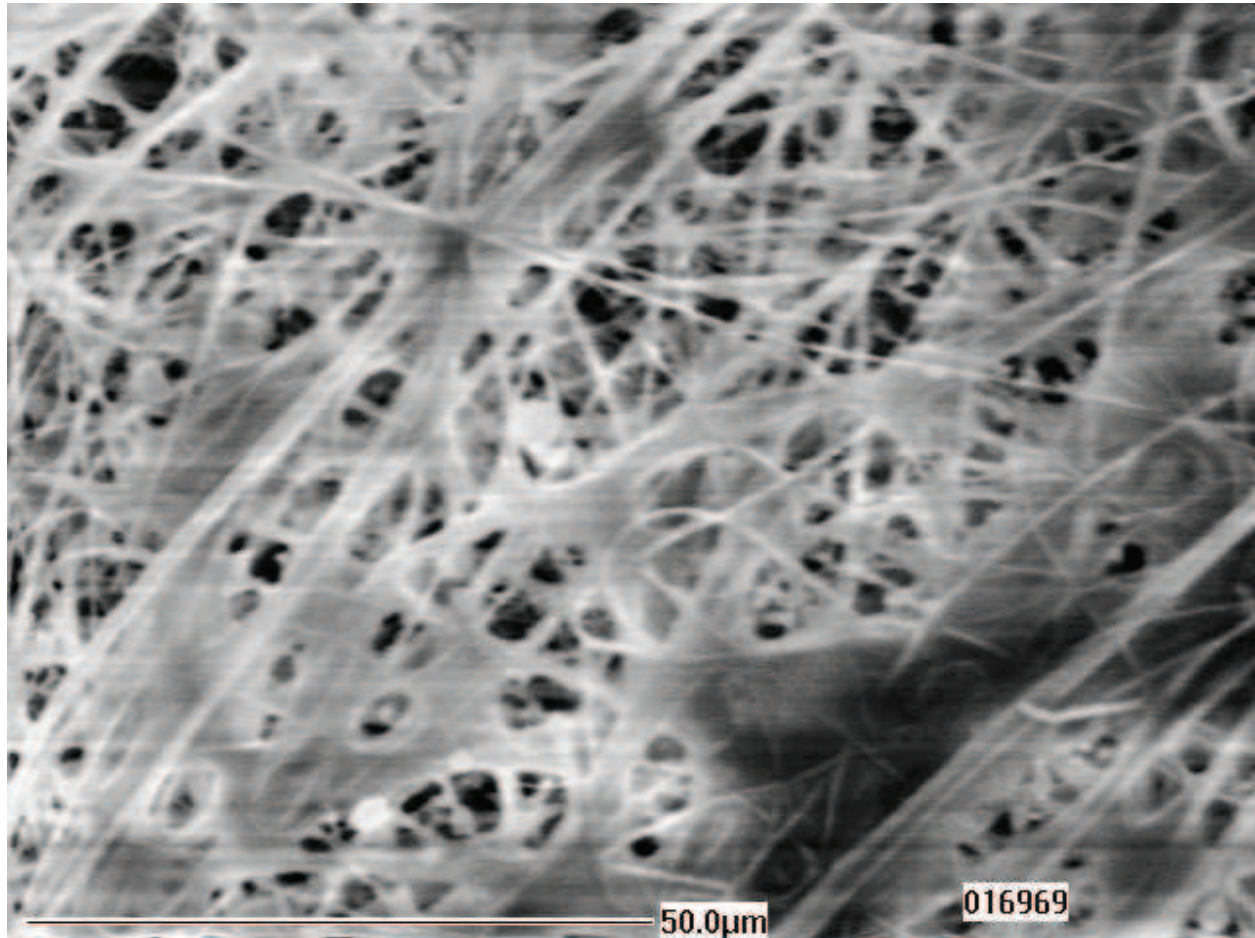
D A Cowper, SEM Senior Analyst
Direct Dial: 01283 554462

SEM-EDS Photomicrographs

Rowland Road Partisol Monitoring Location

Filter ID 1242

Date Sample Taken – 14/01/2010



OCCUPATIONAL HYGIENE & ENVIRONMENTAL MONITORING LABORATORY

RESULTS OF EXAMINATION BY SEM-EDS

Ms R McCollom	Report Number:	OHEM 02349/SEM/0001, Rev 0
Environmental Scientist	Job Number:	OHEM 02349
Wardell Armstrong LLP	Date Received:	19 April 2010
2 The Avenue	Date Analysed:	15 June 2010
Leigh	Sample Description:	PM10 GLA47mm Filter Ref ST1 1278
WN7 1ES	TES Sample ID Number:	016968
	Issue Date:	18 June, 2010
	Page:	7 of 10

Identification of Dust Gauge / Environmental Deposits by SEM-EDS Method Number SEMDG7

Category	Section 1 Estimated %	Section 2 Estimated %	Section 3 Estimated %	Section 4 Estimated %	Section 5 Estimated %	Average Estimated %
Calcium/sulphur rich	17	*	*	5	5	5
Carbonaceous matter	5	5	15	25	10	12
Iron rich	2	5	10	5	*	4
Calcium/aluminium/ silicon rich	15	17	12	12	15	14
Aluminium/silicon/ potassium rich	23	28	23	18	23	23
Silicon rich	38	33	23	25	22	28
Calcium rich	*	*	5	*	5	2
Aluminium/silicon rich	*	5	*	*	10	3
Calcium/silicon rich	*	2	10	*	10	4
Animal/plant fragments	*	5	2	10	*	3

- 99% of particles present were <10µm in size.
- The examination procedure is based on an assessment of forty individual particles selected at random.
- The estimated percentage is based on a comparison of the relative number of particles counted in each category.
- TES Bretby does not accept responsibility for the sampling associated with the results reported above.
- Opinions and interpretations expressed herein are outside the scope of our UKAS accreditation.

Analysed &
Authorised by:



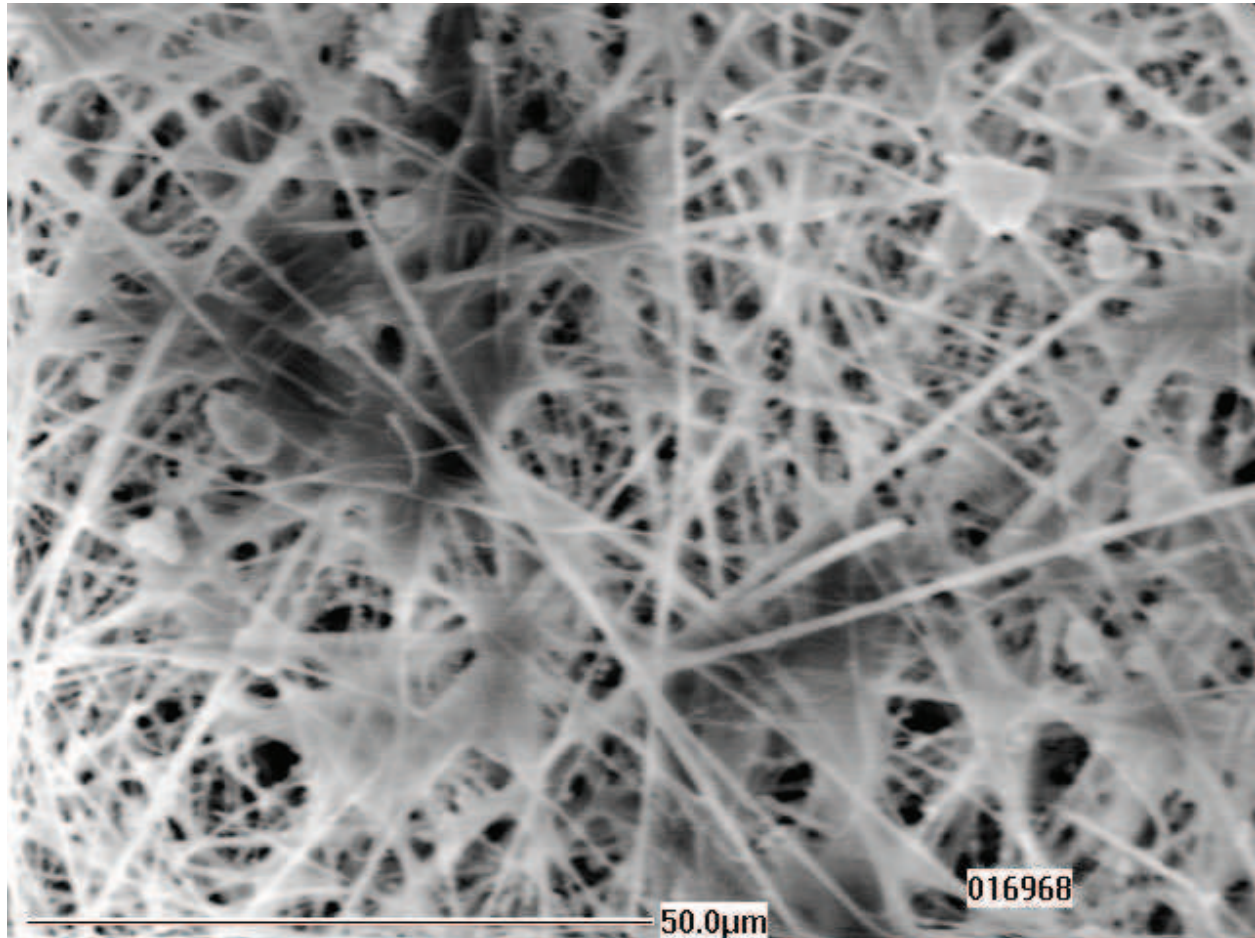
D A Cowper, SEM Senior Analyst
Direct Dial: 01283 554462

SEM-EDS Photomicrographs

Rowland Road Partisol Monitoring Location

Filter ID 1278

Date Sample Taken – 19/02/2010



OCCUPATIONAL HYGIENE & ENVIRONMENTAL MONITORING LABORATORY

RESULTS OF EXAMINATION BY SEM-EDS

Ms R McCollom Environmental Scientist Wardell Armstrong LLP 2 The Avenue Leigh WN7 1ES	Report Number:	OHEM 02107/SEM/0001, Rev 0
	Job Number:	OHEM 02107
	Date Received:	10 March 2010
	Date Analysed:	26 March 2010
	Sample Description:	PM10 GLA47mm Ø Filter Ref 00983/05 Coke Oven 03/03/2010
	TES Sample ID Number:	0015398
	Issue Date:	21 April, 2010
	Page:	17 of 25


Identification of Dust Gauge / Environmental Deposits by SEM-EDS Method Number SEMDG7

Forty particles were analysed individually; the results are shown below.

Category	Estimated %	Category	Estimated %	Category	Estimated %
Carbonaceous matter	88	Animal/plant fragments	10	Aluminium/silicon/ potassium/calcium rich	2
Mass of particulate on filter: 50 µg					

- 100% of particles present were <10µm in size.
- The examination procedure is based on an assessment of forty individual particles selected at random.
- The estimated percentage is based on a comparison of the relative number of particles counted in each category.
- TES Bretby does not accept responsibility for the sampling associated with the results reported above.
- Opinions and interpretations expressed herein are outside the scope of our UKAS accreditation.

Analysed by:


D Rayson, SEM Analyst

Authorised by:

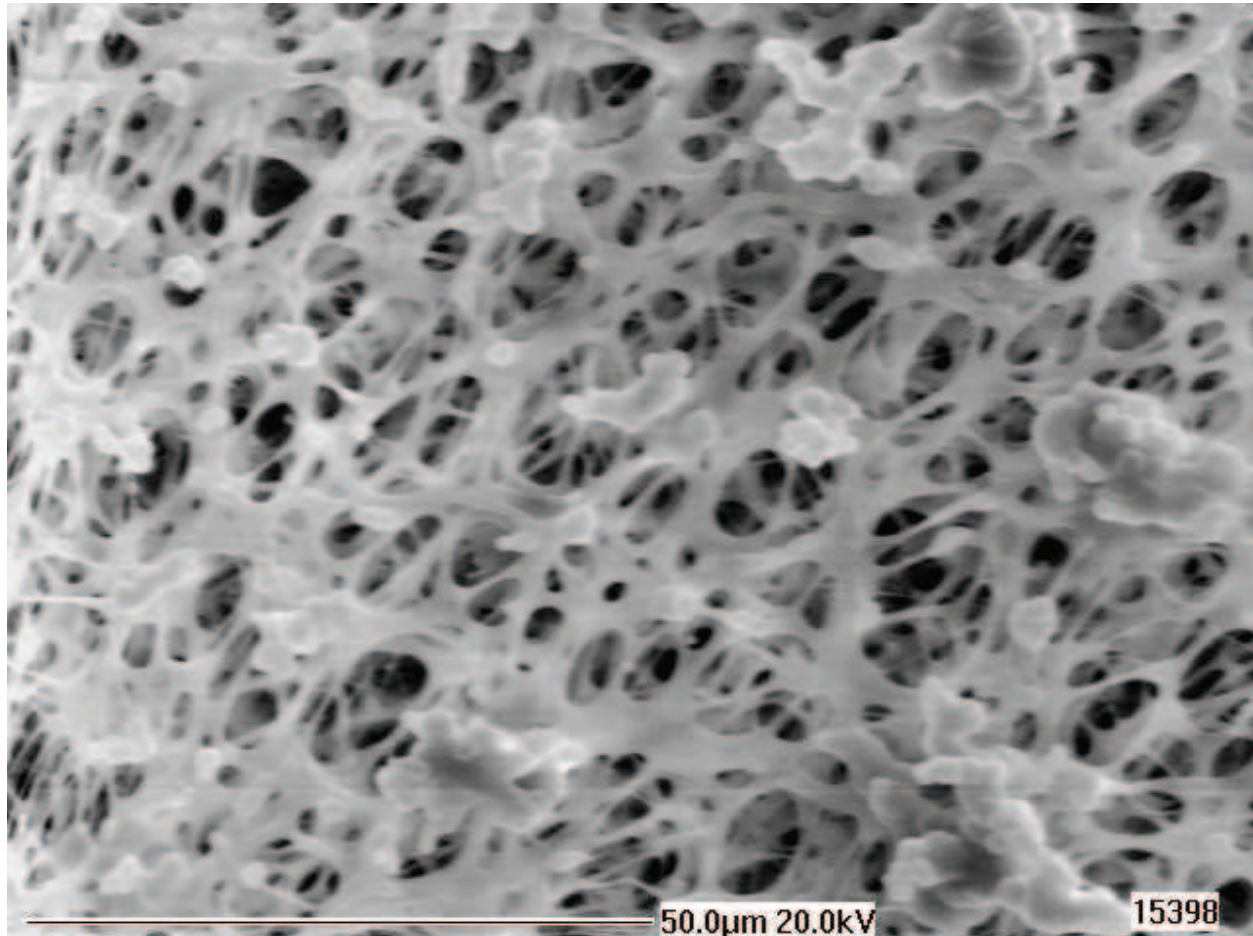

D A Cowper, SEM Senior Analyst
Direct Dial: 01283 554462

SEM-EDS Photomicrographs

Corus Steelworks – Coke Ovens

Filter ID 00983/05

Date Sample Taken – 03/03/2010



OCCUPATIONAL HYGIENE & ENVIRONMENTAL MONITORING LABORATORY

RESULTS OF EXAMINATION BY SEM-EDS

Ms R McCollom Environmental Scientist Wardell Armstrong LLP 2 The Avenue Leigh WN7 1ES	Report Number:	OHEM 02107/SEM/0001, Rev 0
	Job Number:	OHEM 02107
	Date Received:	10 March 2010
	Date Analysed:	26 March 2010
	Sample Description:	PM ₁₀ GLA47mm Ø Filter Ref 00983/07 Coke Oven 03/03/2010
	TES Sample ID Number:	0015395
	Issue Date:	21 April, 2010
	Page:	16 of 25

Identification of Dust Gauge / Environmental Deposits by SEM-EDS Method Number SEMDG7

Forty particles were analysed individually; the results are shown below.

Category	Estimated %	Category	Estimated %	Category	Estimated %
Carbonaceous matter	40	Aluminium/silicon/ calcium/iron rich	5	Aluminium rich	2
Calcium rich	23	Aluminium/silicon rich	5	Silicon/magnesium rich	2
Animal/plant fragments	8	Iron rich	5		
Sodium rich *	5	Sodium/aluminium/ silicon/calcium rich	5		
Mass of particulate on filter: 129 µg					

- * Although the particle has been classified as sodium rich, it is unlikely that it is solely sodium. Due to the filter material used there is large chlorine peak present on every particle, this could mask a chlorine peak arising from the particle itself, and therefore a sodium rich particle could possibly be sodium/chlorine rich.
- 99% of particles present were <10µm in size.
- The examination procedure is based on an assessment of forty individual particles selected at random.
- The estimated percentage is based on a comparison of the relative number of particles counted in each category.
- TES Bretby does not accept responsibility for the sampling associated with the results reported above.
- Opinions and interpretations expressed herein are outside the scope of our UKAS accreditation.

Analysed by:



D Rayson, SEM Analyst

Authorised by:



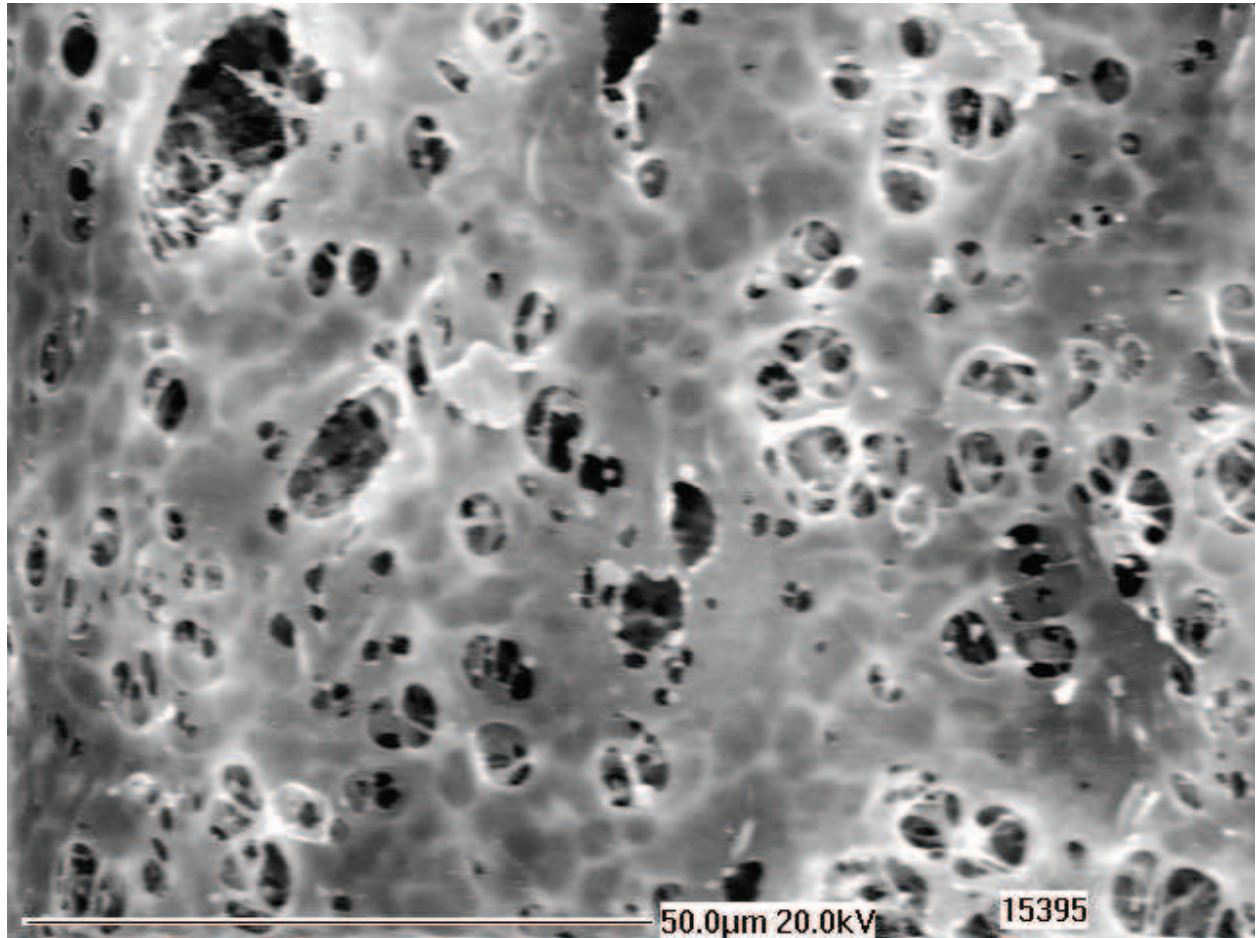
D A Cowper, SEM Senior Analyst
Direct Dial: 01283 554462

SEM-EDS Photomicrographs

Corus Steelworks – Coke Ovens

Filter ID 00983/07

Date Sample Taken – 03/03/2010



OCCUPATIONAL HYGIENE & ENVIRONMENTAL MONITORING LABORATORY

RESULTS OF EXAMINATION BY SEM-EDS

Ms R McCollom Environmental Scientist Wardell Armstrong LLP 2 The Avenue Leigh WN7 1ES	Report Number:	OHEM 02107/SEM/0001, Rev 0
	Job Number:	OHEM 02107
	Date Received:	10 March 2010
	Date Analysed:	26 March 2010
	Sample Description:	PM ₁₀ GLA47mm Ø Filter Ref 00983/10 Coke Oven 03/03/2010
	TES Sample ID Number:	0015401
	Issue Date:	21 April, 2010
	Page:	18 of 25

Identification of Dust Gauge / Environmental Deposits by SEM-EDS Method Number SEMDG7

Forty particles were analysed individually; the results are shown below.

Category	Estimated %	Category	Estimated %	Category	Estimated %
Carbonaceous matter	58	Aluminium rich	5	Magnesium/silicon rich	2
Calcium rich	23	Iron/sulphur rich	2		
Iron rich	8	Sodium rich *	2		
Mass of particulate on filter: 110 µg					

- * Although the particle has been classified as sodium rich, it is unlikely that it is solely sodium. Due to the filter material used there is large chlorine peak present on every particle, this could mask a chlorine peak arising from the particle itself, and therefore a sodium rich particle could possibly be sodium/chlorine rich.
- 99% of particles present were <10µm in size.
- The examination procedure is based on an assessment of forty individual particles selected at random.
- The estimated percentage is based on a comparison of the relative number of particles counted in each category.
- TES Bretby does not accept responsibility for the sampling associated with the results reported above.
- Opinions and interpretations expressed herein are outside the scope of our UKAS accreditation.

Analysed by: 
D Rayson, SEM Analyst

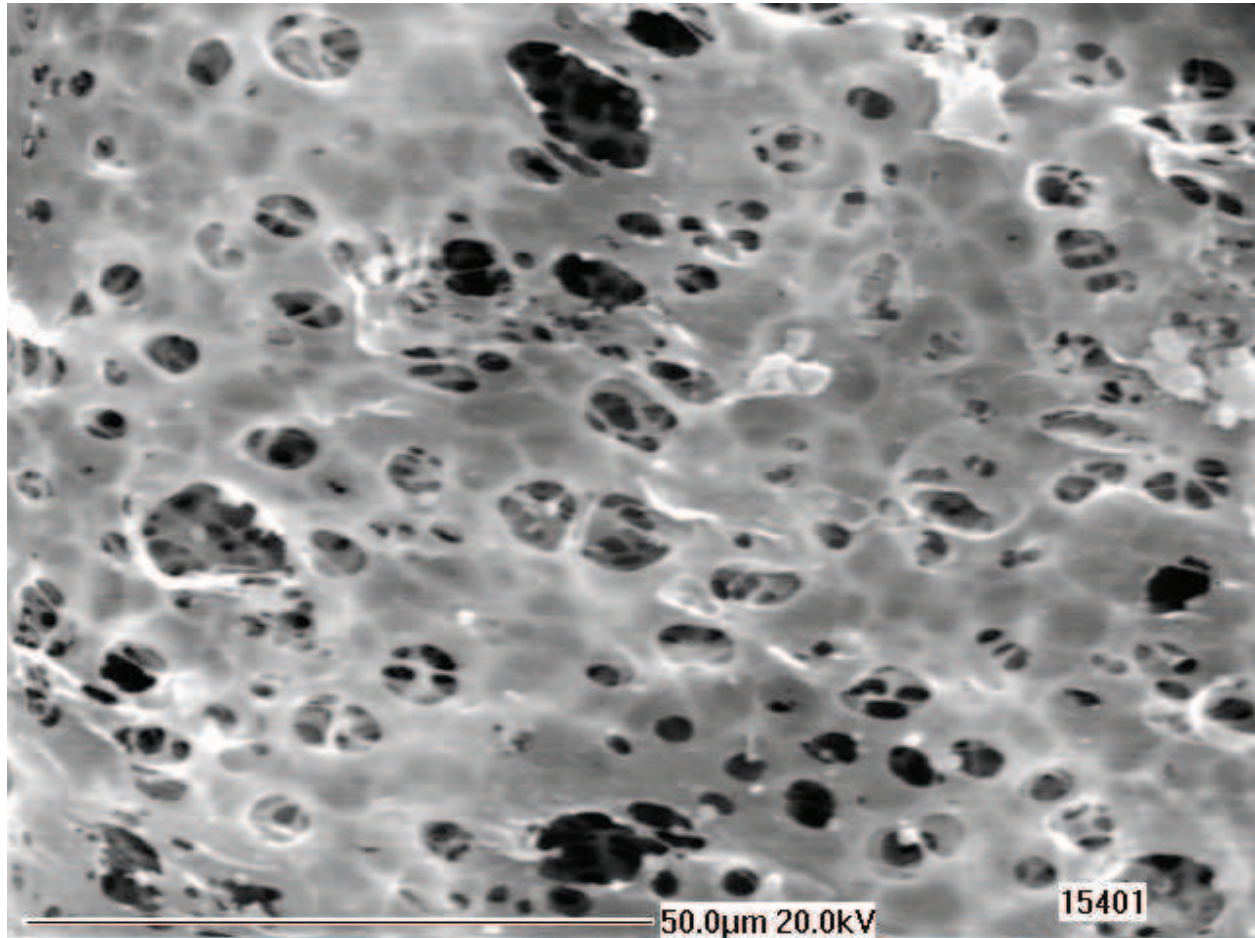
Authorised by: 
D A Cowper, SEM Senior Analyst
Direct Dial: 01283 554462

SEM-EDS Photomicrographs

Corus Steelworks – Coke Ovens

Filter ID 00983/10

Date Sample Taken – 03/03/2010



OCCUPATIONAL HYGIENE & ENVIRONMENTAL MONITORING LABORATORY

RESULTS OF EXAMINATION BY SEM-EDS

Ms R McCollom Environmental Scientist Wardell Armstrong LLP 2 The Avenue Leigh WN7 1ES	Report Number:	OHEM 02107/SEM/0001, Rev 0
	Job Number:	OHEM 02107
	Date Received:	10 March 2010
	Date Analysed:	26 March 2010
	Sample Description:	PM ₁₀ GLA47mm Ø Filter Ref 00983/12 Coke Oven 04/03/2010
	TES Sample ID Number:	0015404
	Issue Date:	21 April, 2010
	Page:	19 of 25

Identification of Dust Gauge / Environmental Deposits by SEM-EDS Method Number SEMDG7

Forty particles were analysed individually; the results are shown below.

Category	Estimated %	Category	Estimated %	Category	Estimated %
Carbonaceous matter	45	Animal/plant fragments	5	Silicon rich	2
Calcium rich	23	Aluminium/silicon/ calcium rich	3	Tin rich	2
Iron rich	8	Aluminium/magnesium / silicon/iron rich	2		
Sodium rich *	8	Aluminium/silicon/ potassium rich	2		
Mass of particulate on filter: 683 µg					

- * Although the particle has been classified as sodium rich, it is unlikely that it is solely sodium. Due to the filter material used there is large chlorine peak present on every particle, this could mask a chlorine peak arising from the particle itself, and therefore a sodium rich particle could possibly be sodium/chlorine rich.
- 99% of particles present were <10µm in size.
- The examination procedure is based on an assessment of forty individual particles selected at random.
- The estimated percentage is based on a comparison of the relative number of particles counted in each category.
- TES Bretby does not accept responsibility for the sampling associated with the results reported above.
- Opinions and interpretations expressed herein are outside the scope of our UKAS accreditation.

Analysed by: 
D Rayson, SEM Analyst

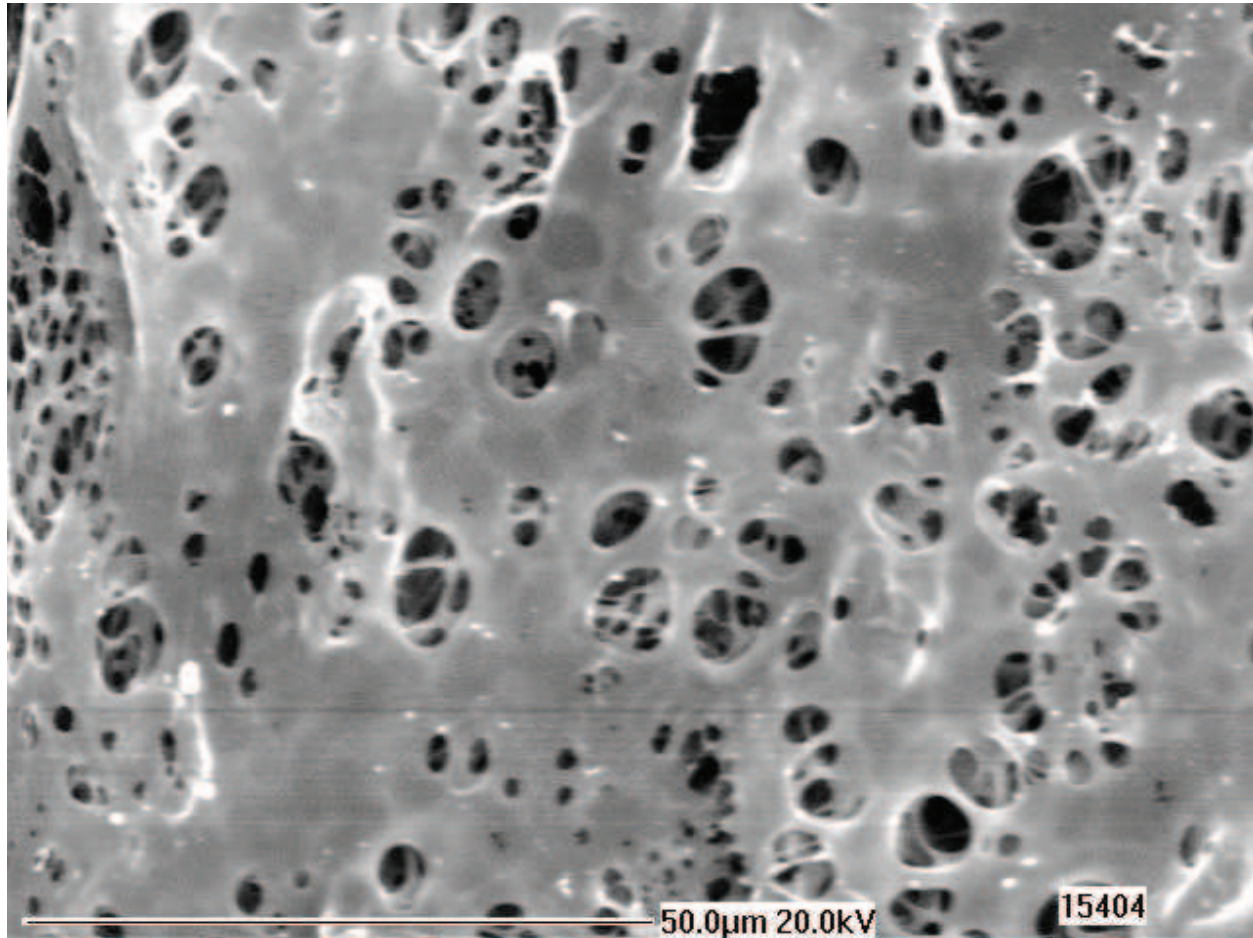
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D A Cowper, SEM Senior Analyst
Direct Dial: 01283 554462

SEM-EDS Photomicrographs

Corus Steelworks – Coke Ovens

Filter ID 00983/12

Date Sample Taken – 04/03/2010



OCCUPATIONAL HYGIENE & ENVIRONMENTAL MONITORING LABORATORY

RESULTS OF EXAMINATION BY SEM-EDS

Ms R McCollom Environmental Scientist Wardell Armstrong LLP 2 The Avenue Leigh WN7 1ES	Report Number:	OHEM 02107/SEM/0001, Rev 0
	Job Number:	OHEM 02107
	Date Received:	10 March 2010
	Date Analysed:	26 March 2010
	Sample Description:	PM ₁₀ GLA47mm Ø Filter Ref 00983/15 Coke Oven 04/03/2010
	TES Sample ID Number:	0015407
	Issue Date:	21 April, 2010
	Page:	20 of 25

Identification of Dust Gauge / Environmental Deposits by SEM-EDS Method Number SEMDG7

Forty particles were analysed individually; the results are shown below.

Category	Estimated %
Carbonaceous matter	100
Mass of particulate on filter: 233 µg	

- 99% of particles present were <10µm in size.
- The examination procedure is based on an assessment of forty individual particles selected at random.
- The estimated percentage is based on a comparison of the relative number of particles counted in each category.
- TES Bretby does not accept responsibility for the sampling associated with the results reported above.
- Opinions and interpretations expressed herein are outside the scope of our UKAS accreditation.

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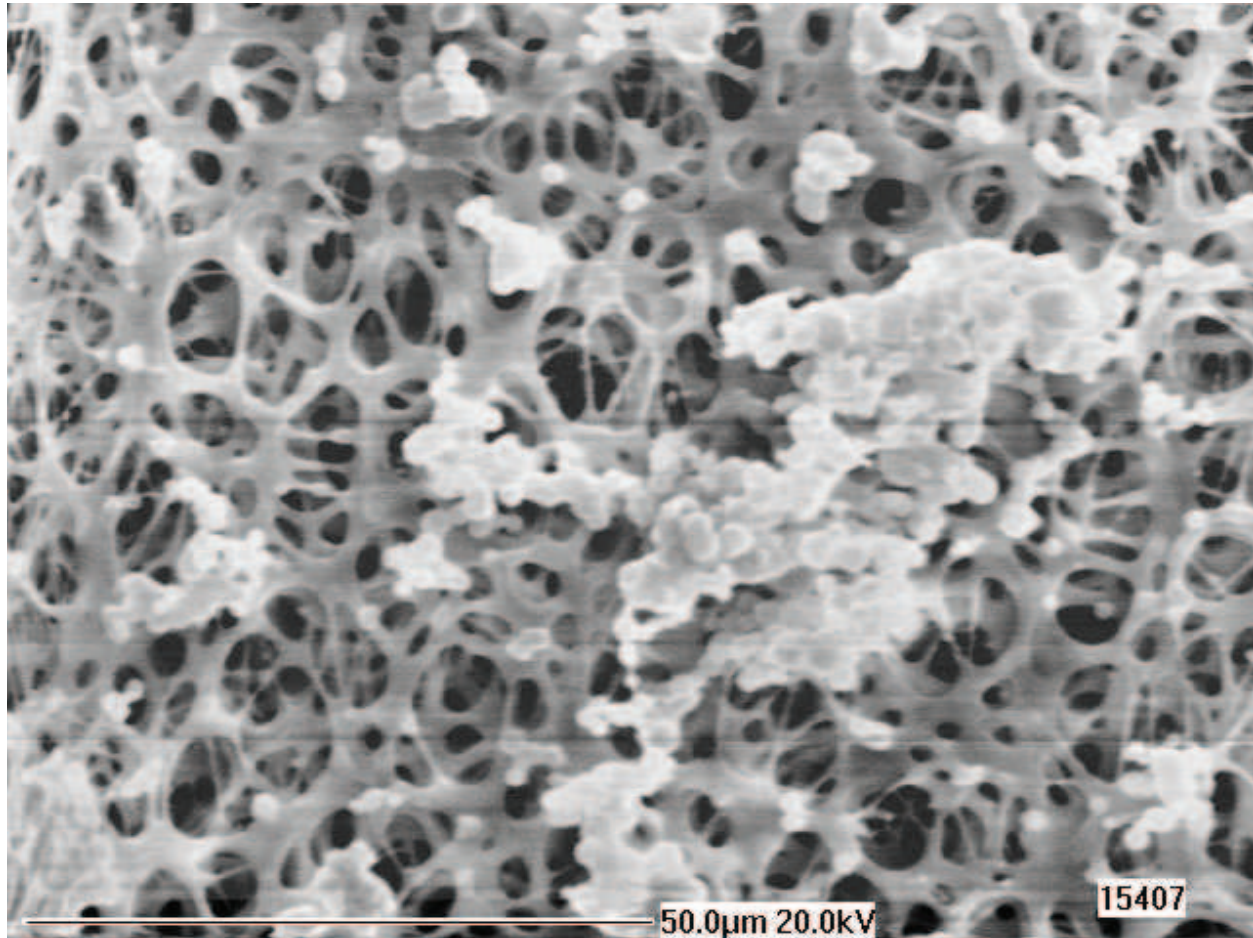
D A Cowper, SEM Senior Analyst
Direct Dial: 01283 554462

SEM-EDS Photomicrographs

Corus Steelworks – Coke Ovens

Filter ID 00983/15

Date Sample Taken – 04/03/2010



OCCUPATIONAL HYGIENE & ENVIRONMENTAL MONITORING LABORATORY

RESULTS OF EXAMINATION BY SEM-EDS

Ms R McCollom Environmental Scientist Wardell Armstrong LLP 2 The Avenue Leigh WN7 1ES	Report Number:	OHEM 02107/SEM/0001, Rev 0
	Job Number:	OHEM 02107
	Date Received:	10 March 2010
	Date Analysed:	25 March 2010
	Sample Description:	PM ₁₀ GLA47mm Ø Filter Ref 00983/20 Sinter Plant (Strands) 04/03/2010
	TES Sample ID Number:	0015363
	Issue Date:	21 April, 2010
	Page:	6 of 25

Identification of Dust Gauge / Environmental Deposits by SEM-EDS Method Number SEMDG7

Forty particles were analysed individually; the results are shown below.

Category	Estimated %	Category	Estimated %
Carbonaceous matter	85	Calcium/iron	3
Animal/plant fragments	10	Iron rich	2
Mass of particulate on filter: 945 µg			

- 99% of particles present were <10µm in size.
- The examination procedure is based on an assessment of forty individual particles selected at random.
- The estimated percentage is based on a comparison of the relative number of particles counted in each category.
- TES Bretby does not accept responsibility for the sampling associated with the results reported above.
- Opinions and interpretations expressed herein are outside the scope of our UKAS accreditation.

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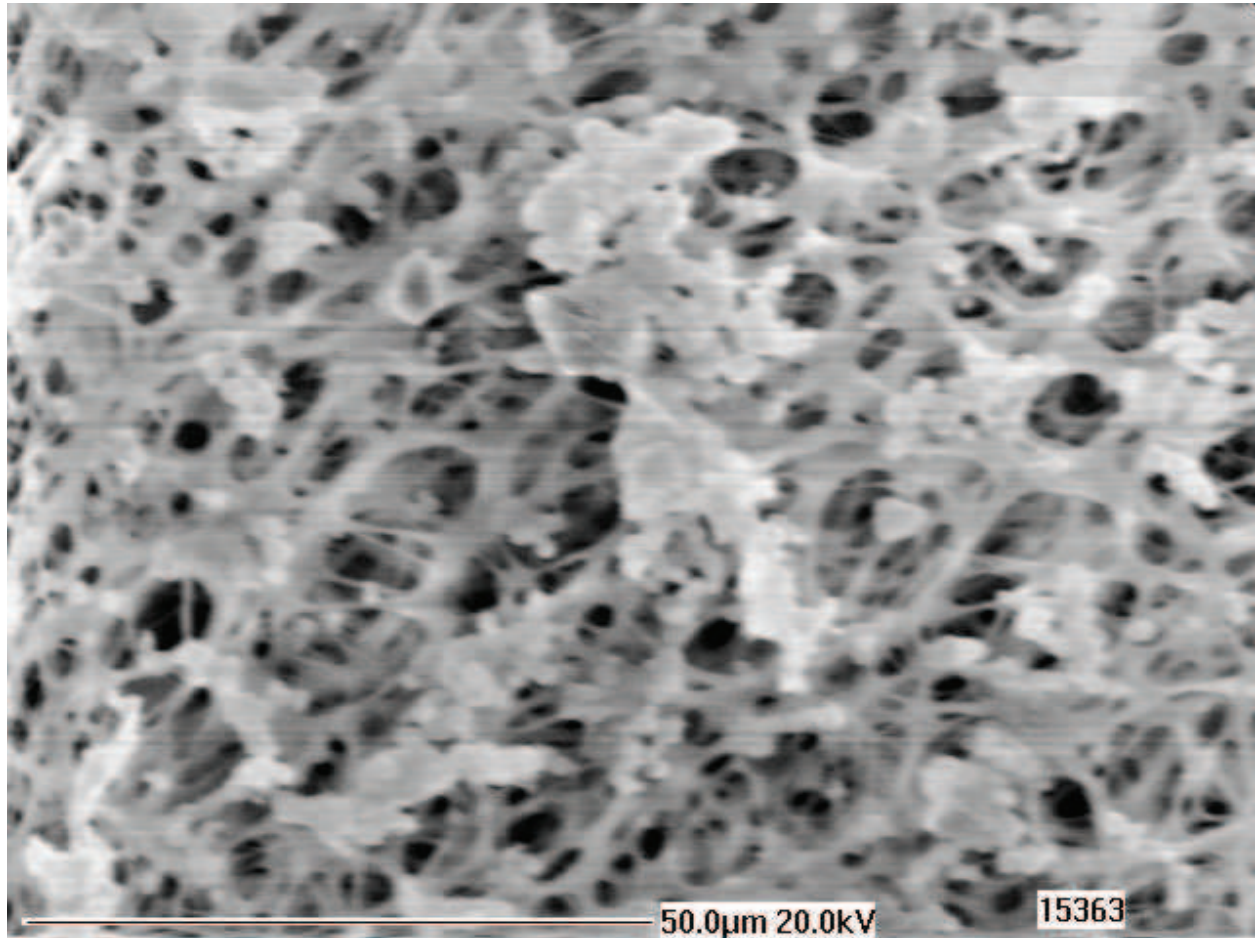
D A Cowper, SEM Senior Analyst
Direct Dial: 01283 554462

SEM-EDS Photomicrographs

Corus Steelworks – Sinter Plant

Filter ID 00983/20

Date Sample Taken – 04/03/2010



OCCUPATIONAL HYGIENE & ENVIRONMENTAL MONITORING LABORATORY

RESULTS OF EXAMINATION BY SEM-EDS

Ms R McCollom Environmental Scientist Wardell Armstrong LLP 2 The Avenue Leigh WN7 1ES	Report Number:	OHEM 02107/SEM/0001, Rev 0
	Job Number:	OHEM 02107
	Date Received:	10 March 2010
	Date Analysed:	25 March 2010
	Sample Description:	PM ₁₀ GLA47mm Ø Filter Ref 00983/21 Sinter Plant (Strands) 04/03/2010
	TES Sample ID Number:	0015366
	Issue Date:	21 April, 2010
	Page:	7 of 25

Identification of Dust Gauge / Environmental Deposits by SEM-EDS Method Number SEMDG7

Forty particles were analysed individually; the results are shown below.

Category	Estimated %	Category	Estimated %	Category	Estimated %
Carbonaceous matter	40	Calcium rich	20	Silicon rich	5
Iron rich	25	Animal/plant fragments	8	Aluminium rich	2
Mass of particulate on filter: 216 µg					

- 99% of particles present were <10µm in size.
- The examination procedure is based on an assessment of forty individual particles selected at random.
- The estimated percentage is based on a comparison of the relative number of particles counted in each category.
- TES Bretby does not accept responsibility for the sampling associated with the results reported above.
- Opinions and interpretations expressed herein are outside the scope of our UKAS accreditation.

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Authorised by:**



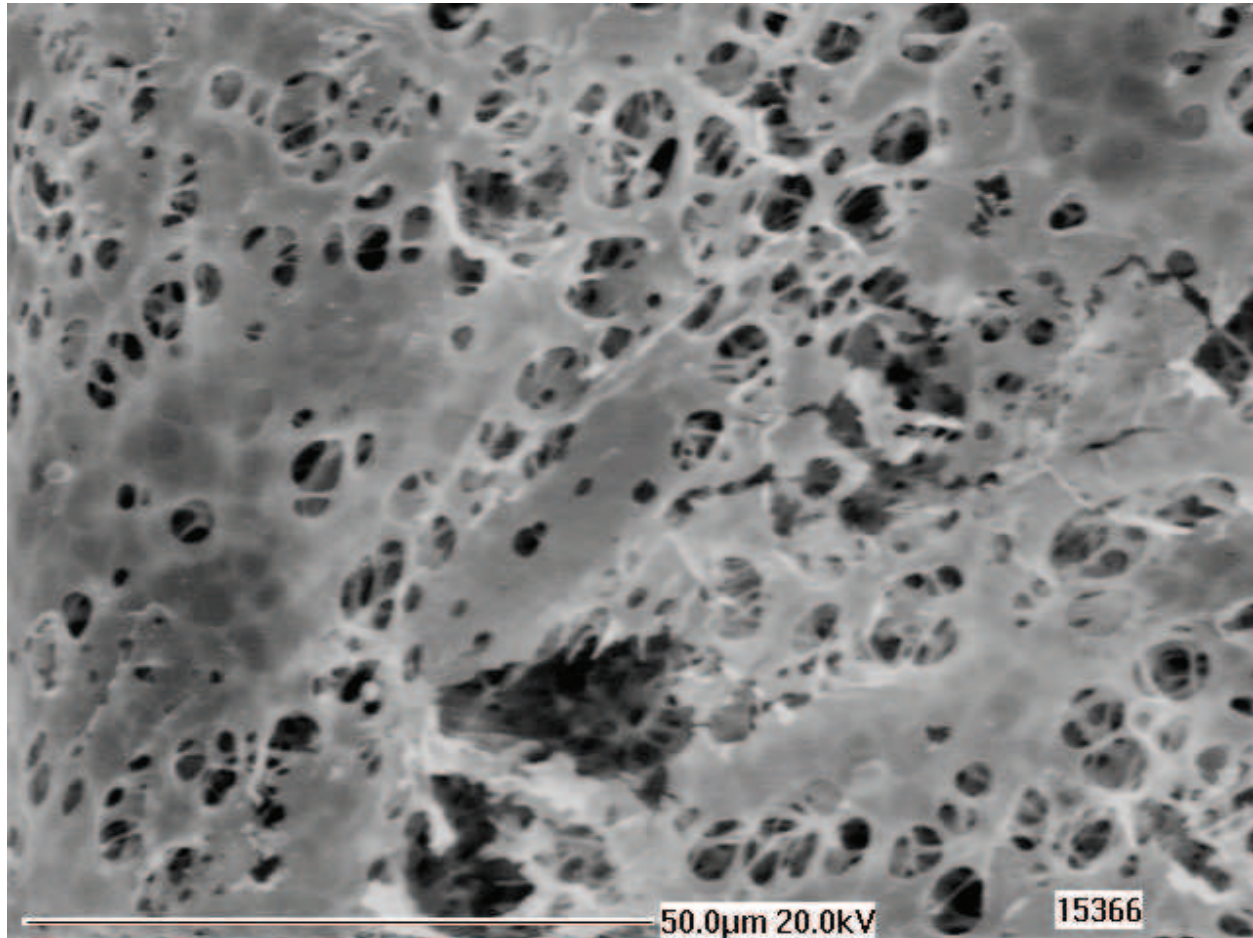
D A Cowper, SEM Senior Analyst
Direct Dial: 01283 554462

SEM-EDS Photomicrographs

Corus Steelworks – Sinter Plant

Filter ID 00983/21

Date Sample Taken – 04/03/2010



OCCUPATIONAL HYGIENE & ENVIRONMENTAL MONITORING LABORATORY

RESULTS OF EXAMINATION BY SEM-EDS

Ms R McCollom Environmental Scientist Wardell Armstrong LLP 2 The Avenue Leigh WN7 1ES	Report Number:	OHEM 02107/SEM/0001, Rev 0
	Job Number:	OHEM 02107
	Date Received:	10 March 2010
	Date Analysed:	25 March 2010
	Sample Description:	PM ₁₀ GLA47mm Ø Filter Ref 00983/26 Sinter Plant (Strands) 04/03/2010
	TES Sample ID Number:	0015369
	Issue Date:	21 April, 2010
	Page:	8 of 25

Identification of Dust Gauge / Environmental Deposits by SEM-EDS Method Number SEMDG7

Forty particles were analysed individually; the results are shown below.

Category	Estimated %
Carbonaceous matter	97
Iron rich	3
Mass of particulate on filter: 434 µg	

- 99% of particles present were <10µm in size.
- The examination procedure is based on an assessment of forty individual particles selected at random.
- The estimated percentage is based on a comparison of the relative number of particles counted in each category.
- TES Bretby does not accept responsibility for the sampling associated with the results reported above.
- Opinions and interpretations expressed herein are outside the scope of our UKAS accreditation.

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Authorised by:



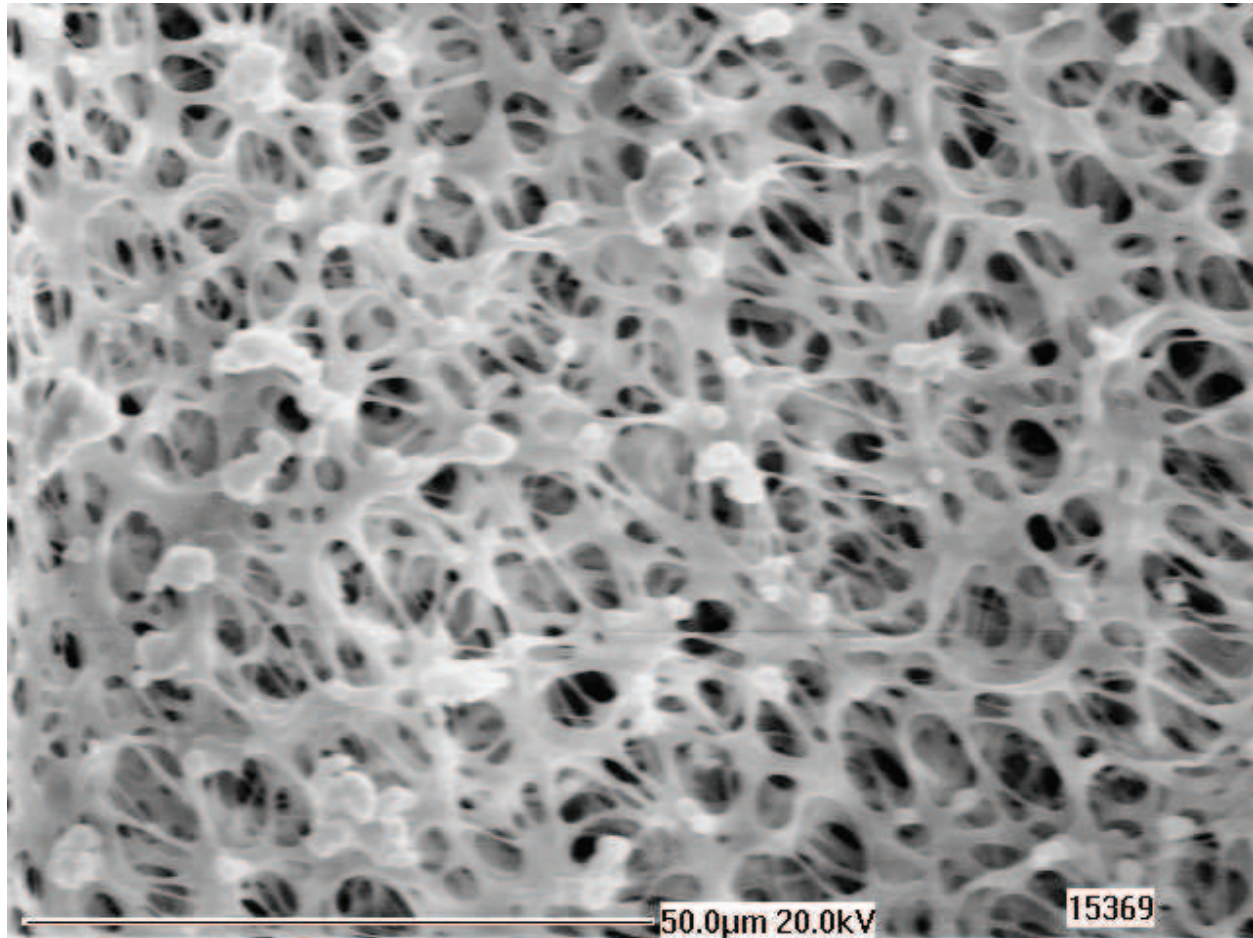
D A Cowper, SEM Senior Analyst
Direct Dial: 01283 554462

SEM-EDS Photomicrographs

Corus Steelworks – Sinter Plant

Filter ID 00983/26

Date Sample Taken – 04/03/2010



OCCUPATIONAL HYGIENE & ENVIRONMENTAL MONITORING LABORATORY

RESULTS OF EXAMINATION BY SEM-EDS

Ms R McCollom Environmental Scientist Wardell Armstrong LLP 2 The Avenue Leigh WN7 1ES	Report Number:	OHEM 02107/SEM/0001, Rev 0
	Job Number:	OHEM 02107
	Date Received:	10 March 2010
	Date Analysed:	25 March 2010
	Sample Description:	PM ₁₀ GLA47mm Ø Filter Ref 00983/27 Sinter Plant (Strands) 04/03/2010
	TES Sample ID Number:	0015372
	Issue Date:	21 April, 2010
	Page:	9 of 25

Identification of Dust Gauge / Environmental Deposits by SEM-EDS Method Number SEMDG7

Forty particles were analysed individually; the results are shown below.

Category	Estimated %	Category	Estimated %	Category	Estimated %
Iron rich	20	Silicon/calcium rich	10	Aluminium/silicon/ potassium rich	2
Calcium/iron rich	20	Aluminium/silicon/ calcium/iron rich	8	Aluminium rich	2
Carbonaceous matter	18	Magnesium/aluminium /silicon/calcium rich	3	Magnesium/aluminium/ silicon rich	2
Calcium rich	13	Magnesium/silicon/ calcium/iron rich	2		
Mass of particulate on filter: 865 µg					

- 100% of particles present were <10µm in size.
- The examination procedure is based on an assessment of forty individual particles selected at random.
- The estimated percentage is based on a comparison of the relative number of particles counted in each category.
- TES Bretby does not accept responsibility for the sampling associated with the results reported above.
- Opinions and interpretations expressed herein are outside the scope of our UKAS accreditation.

Analysed by: 
D Rayson, SEM Analyst

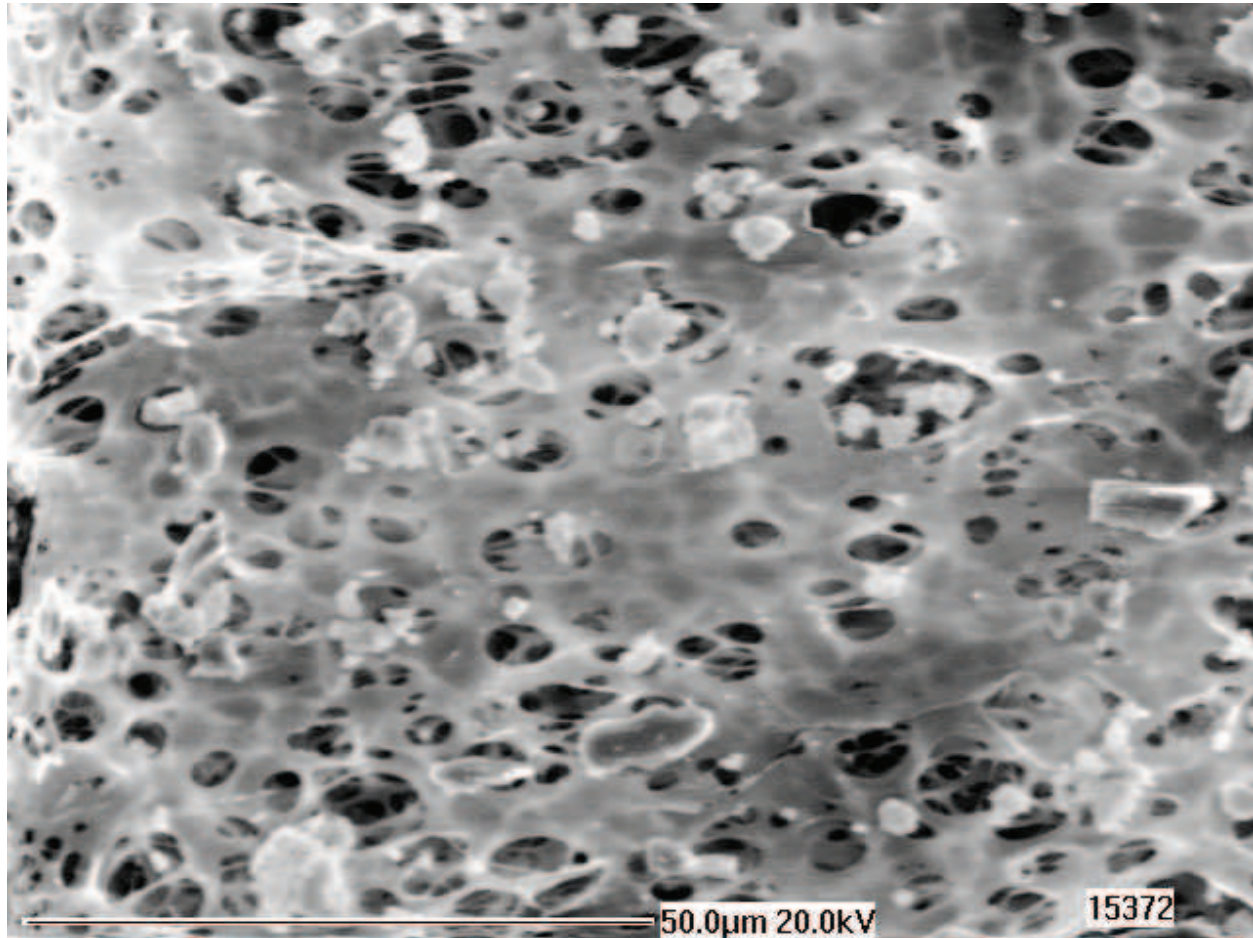
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D A Cowper, SEM Senior Analyst
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SEM-EDS Photomicrographs

Corus Steelworks – Sinter Plant

Filter ID 00983/27

Date Sample Taken – 04/03/2010



OCCUPATIONAL HYGIENE & ENVIRONMENTAL MONITORING LABORATORY

RESULTS OF EXAMINATION BY SEM-EDS

Ms R McCollom Environmental Scientist Wardell Armstrong LLP 2 The Avenue Leigh WN7 1ES	Report Number:	OHEM 02107/SEM/0001, Rev 0
	Job Number:	OHEM 02107
	Date Received:	10 March 2010
	Date Analysed:	25 March 2010
	Sample Description:	PM ₁₀ GLA47mm Ø Filter Ref 00983/30 Sinter Plant (Strands) 04/03/2010
	TES Sample ID Number:	0015375
	Issue Date:	21 April, 2010
	Page:	10 of 25


Identification of Dust Gauge / Environmental Deposits by SEM-EDS Method Number SEMDG7

Forty particles were analysed individually; the results are shown below.

Category	Estimated %	Category	Estimated %	Category	Estimated %
Carbonaceous matter	18	Silicon/calcium/iron rich	8	Animal/plant fragments	2
Calcium/iron rich	18	Magnesium/silicon/calcium/iron rich	5	Calcium/sulphur rich	2
Calcium rich	18	Silicon/calcium rich	2		
Iron rich	13	Iron/magnesium rich	2		
Aluminium/silicon/calcium/iron rich	10	Calcium/Iron/manganese rich	2		
Mass of particulate on filter: 1174 µg					

- 99% of particles present were <10µm in size.
- The examination procedure is based on an assessment of forty individual particles selected at random.
- The estimated percentage is based on a comparison of the relative number of particles counted in each category.
- TES Bretby does not accept responsibility for the sampling associated with the results reported above.
- Opinions and interpretations expressed herein are outside the scope of our UKAS accreditation.

Analysed by:


D Rayson, SEM Analyst

Authorised by:



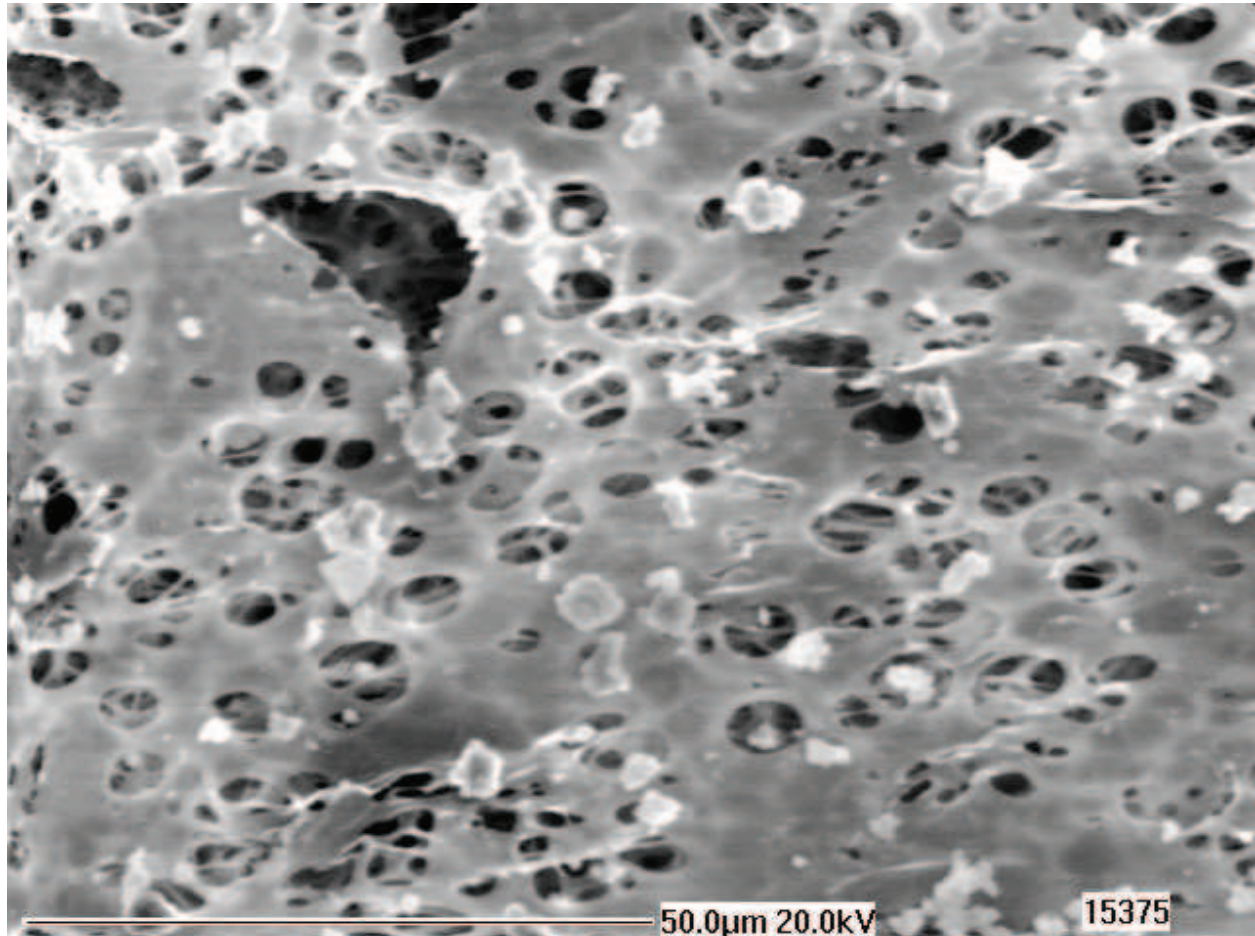
D A Cowper, SEM Senior Analyst
Direct Dial: 01283 554462

SEM-EDS Photomicrographs

Corus Steelworks – Sinter Plant

Filter ID 00983/30

Date Sample Taken – 04/03/2010



OCCUPATIONAL HYGIENE & ENVIRONMENTAL MONITORING LABORATORY

RESULTS OF EXAMINATION BY SEM-EDS

Ms R McCollom Environmental Scientist Wardell Armstrong LLP 2 The Avenue Leigh WN7 1ES	Report Number:	OHEM 02107/SEM/0001, Rev 0
	Job Number:	OHEM 02107
	Date Received:	10 March 2010
	Date Analysed:	25 March 2010
	Sample Description:	PM ₁₀ GLA47mm Ø Filter Ref 00983/63 Blast Furnace Cast House 03/03/2010
	TES Sample ID Number:	0015378
	Issue Date:	21 April, 2010
	Page:	11 of 25

Identification of Dust Gauge / Environmental Deposits by SEM-EDS Method Number SEMDG7

Forty particles were analysed individually; the results are shown below.

Category	Estimated %	Category	Estimated %
Carbonaceous matter	90	Calcium/iron rich	3
Aluminium/silicon rich	5	Silicon rich	2
Mass of particulate on filter: 128 µg			

- 99% of particles present were <10µm in size.
- The examination procedure is based on an assessment of forty individual particles selected at random.
- The estimated percentage is based on a comparison of the relative number of particles counted in each category.
- TES Bretby does not accept responsibility for the sampling associated with the results reported above.
- Opinions and interpretations expressed herein are outside the scope of our UKAS accreditation.

Analysed by: 
D Rayson, SEM Analyst

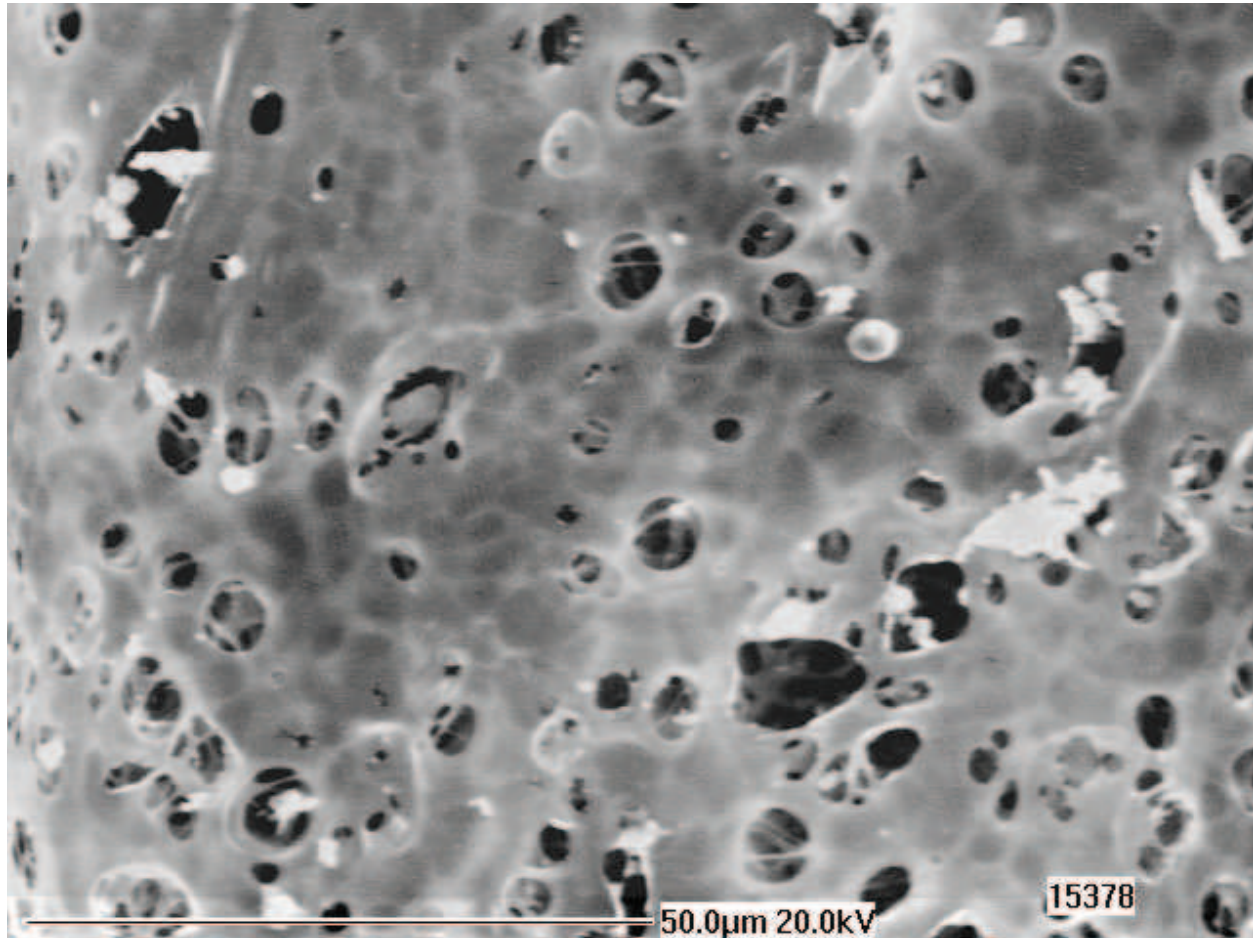
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D A Cowper, SEM Senior Analyst
Direct Dial: 01283 554462

SEM-EDS Photomicrographs

Corus Steelworks – Blast Furnace Cast House

Filter ID 00983/63

Date Sample Taken – 03/03/2010



OCCUPATIONAL HYGIENE & ENVIRONMENTAL MONITORING LABORATORY

RESULTS OF EXAMINATION BY SEM-EDS

Ms R McCollom Environmental Scientist Wardell Armstrong LLP 2 The Avenue Leigh WN7 1ES	Report Number:	OHEM 02107/SEM/0001, Rev 0
	Job Number:	OHEM 02107
	Date Received:	10 March 2010
	Date Analysed:	25 March 2010
	Sample Description:	PM ₁₀ GLA47mm Ø Filter Ref 00983/66 Blast Furnace Cast House 03/03/2010
	TES Sample ID Number:	0015381
	Issue Date:	21 April, 2010
	Page:	12 of 25

Identification of Dust Gauge / Environmental Deposits by SEM-EDS Method Number SEMDG7

Forty particles were analysed individually; the results are shown below.

Category	Estimated %	Category	Estimated %	Category	Estimated %
Carbonaceous matter	85	Animal/plant fragments	5	Aluminium rich	2
Iron rich	5	Aluminium/silicon rich	3		
Mass of particulate on filter: 110 µg					

- 99% of particles present were <10µm in size.
- The examination procedure is based on an assessment of forty individual particles selected at random.
- The estimated percentage is based on a comparison of the relative number of particles counted in each category.
- TES Bretby does not accept responsibility for the sampling associated with the results reported above.
- Opinions and interpretations expressed herein are outside the scope of our UKAS accreditation.

Analysed by: 
D Rayson, SEM Analyst

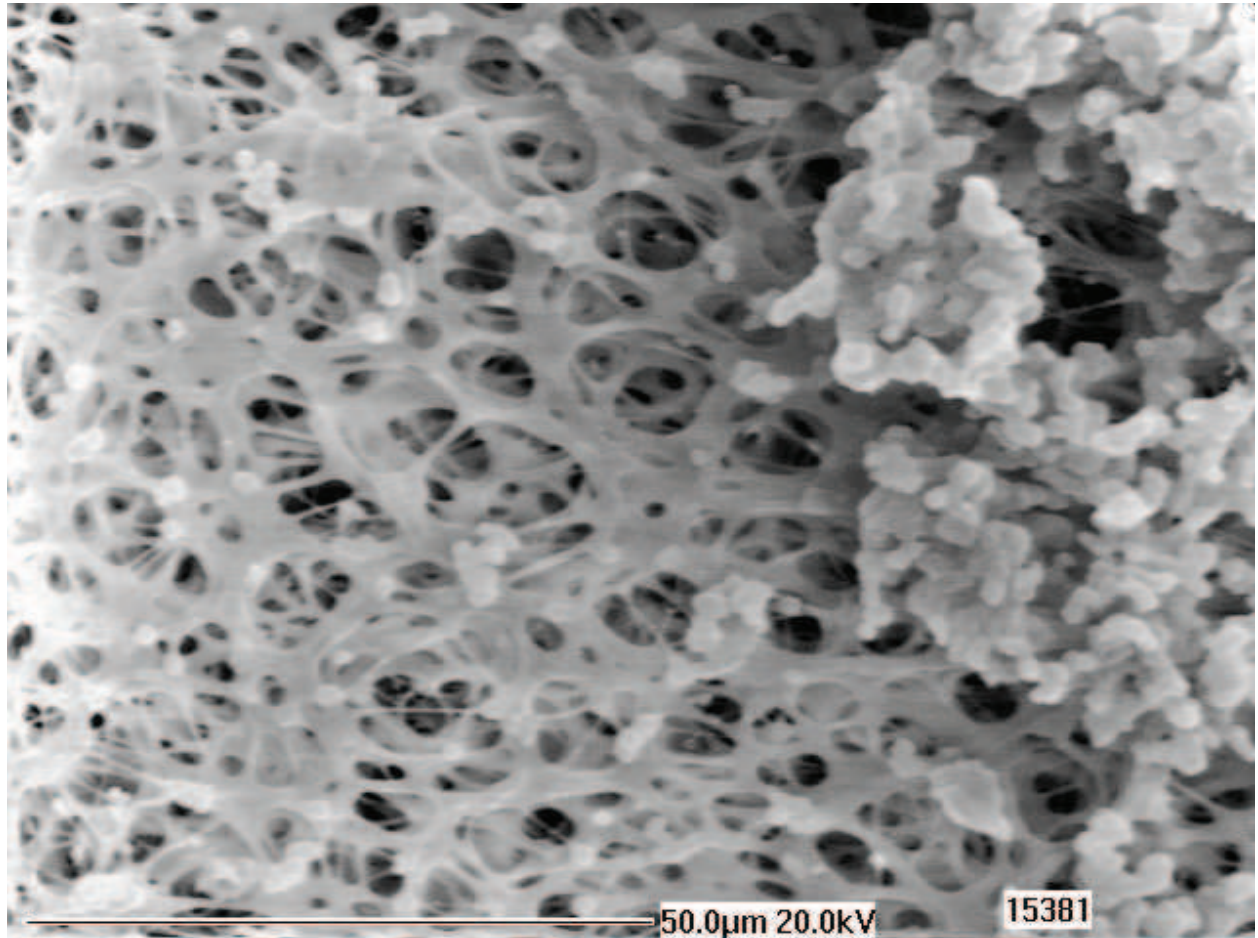
Authorised by: 
D A Cowper, SEM Senior Analyst
Direct Dial: 01283 554462

SEM-EDS Photomicrographs

Corus Steelworks – Blast Furnace Cast House

Filter ID 00983/66

Date Sample Taken – 03/03/2010



OCCUPATIONAL HYGIENE & ENVIRONMENTAL MONITORING LABORATORY

RESULTS OF EXAMINATION BY SEM-EDS

Ms R McCollom Environmental Scientist Wardell Armstrong LLP 2 The Avenue Leigh WN7 1ES	Report Number:	OHEM 02107/SEM/0001, Rev 0
	Job Number:	OHEM 02107
	Date Received:	10 March 2010
	Date Analysed:	26 March 2010
	Sample Description:	PM ₁₀ GLA47mm Ø Filter Ref 00983/69 Blast Furnace Cast House 03/03/2010
	TES Sample ID Number:	0015384
	Issue Date:	21 April, 2010
	Page:	13 of 25

Identification of Dust Gauge / Environmental Deposits by SEM-EDS Method Number SEMDG7

Forty particles were analysed individually; the results are shown below.

Category	Estimated %	Category	Estimated %
Carbonaceous matter	95	Animal/plant fragments	2
Iron/aluminium/silicon rich	3		
Mass of particulate on filter: 470 µg			

- 99% of particles present were <10µm in size.
- The examination procedure is based on an assessment of forty individual particles selected at random.
- The estimated percentage is based on a comparison of the relative number of particles counted in each category.
- TES Bretby does not accept responsibility for the sampling associated with the results reported above.
- Opinions and interpretations expressed herein are outside the scope of our UKAS accreditation.

Analysed &
Authorised by:



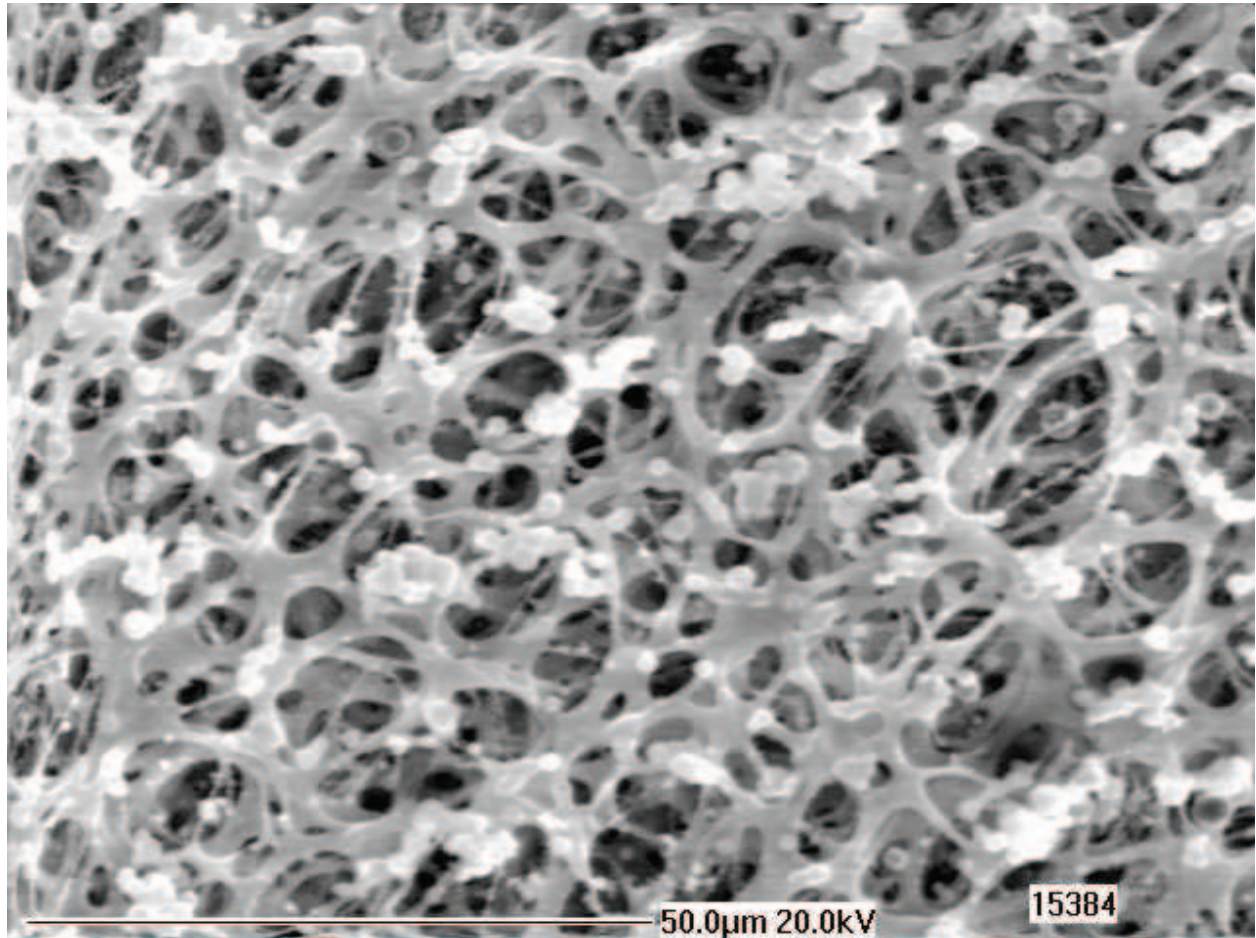
D A Cowper, SEM Senior Analyst
Direct Dial: 01283 554462

SEM-EDS Photomicrographs

Corus Steelworks – Blast Furnace Cast House

Filter ID 00983/69

Date Sample Taken – 03/03/2010



OCCUPATIONAL HYGIENE & ENVIRONMENTAL MONITORING LABORATORY

RESULTS OF EXAMINATION BY SEM-EDS

Ms R McCollom Environmental Scientist Wardell Armstrong LLP 2 The Avenue Leigh WN7 1ES	Report Number:	OHEM 02107/SEM/0001, Rev 0
	Job Number:	OHEM 02107
	Date Received:	10 March 2010
	Date Analysed:	26 March 2010
	Sample Description:	PM ₁₀ GLA47mm Ø Filter Ref 00983/74 Blast Furnace Cast House 03/03/2010
	TES Sample ID Number:	0015389
	Issue Date:	21 April, 2010
	Page:	14 of 25

Identification of Dust Gauge / Environmental Deposits by SEM-EDS Method Number SEMDG7

Forty particles were analysed individually; the results are shown below.

Category	Estimated %
Carbonaceous matter	97
Silicon rich	3
Mass of particulate on filter: 3548 µg	

- 99% of particles present were <10µm in size.
- The examination procedure is based on an assessment of forty individual particles selected at random.
- The estimated percentage is based on a comparison of the relative number of particles counted in each category.
- TES Bretby does not accept responsibility for the sampling associated with the results reported above.
- Opinions and interpretations expressed herein are outside the scope of our UKAS accreditation.

Analysed &
Authorised by:



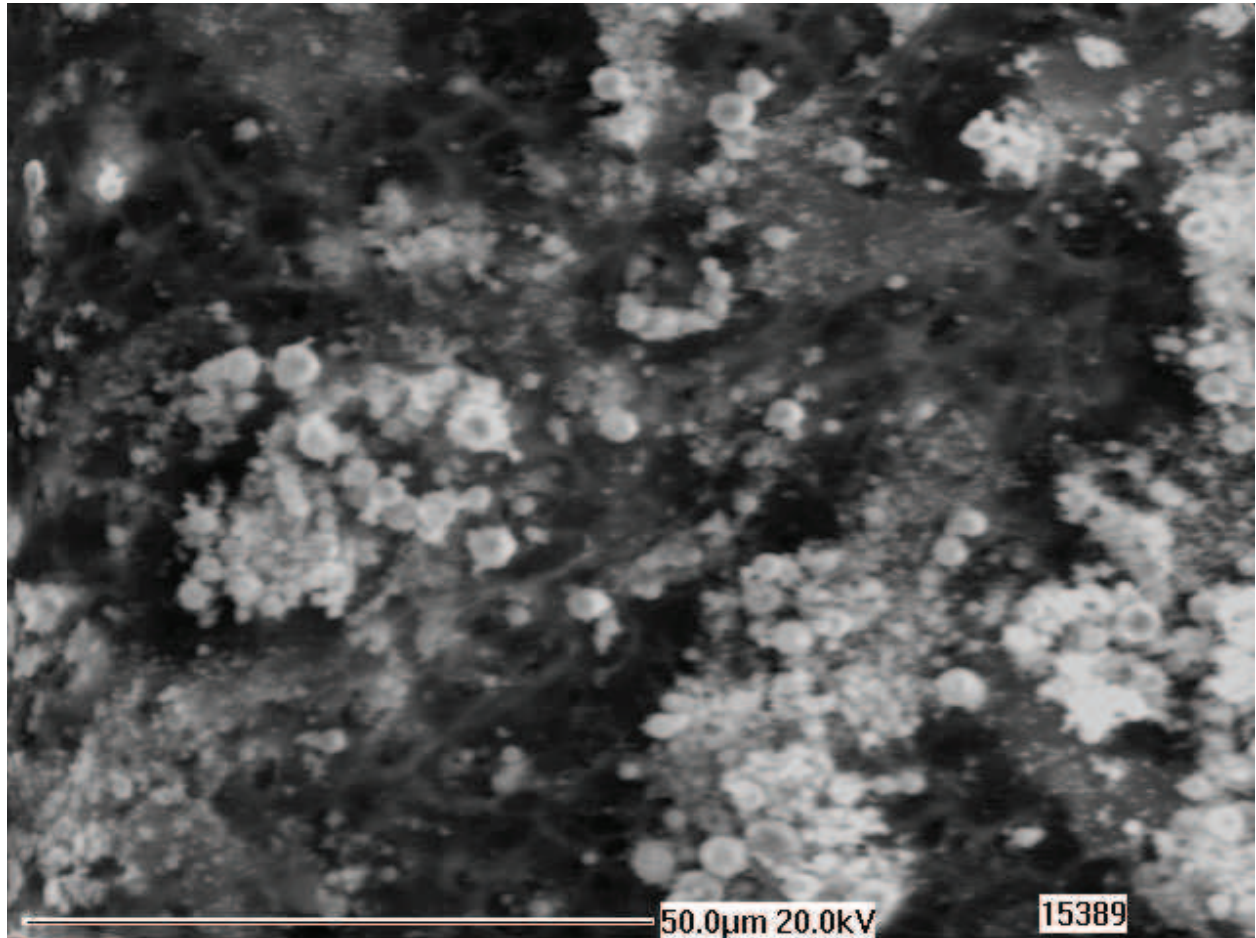
D A Cowper, SEM Senior Analyst
Direct Dial: 01283 554462

SEM-EDS Photomicrographs

Corus Steelworks – Blast Furnace Cast House

Filter ID 00983/74

Date Sample Taken – 03/03/2010



OCCUPATIONAL HYGIENE & ENVIRONMENTAL MONITORING LABORATORY

RESULTS OF EXAMINATION BY SEM-EDS

Ms R McCollom Environmental Scientist Wardell Armstrong LLP 2 The Avenue Leigh WN7 1ES	Report Number:	OHEM 02107/SEM/0001, Rev 0
	Job Number:	OHEM 02107
	Date Received:	10 March 2010
	Date Analysed:	26 March 2010
	Sample Description:	PM ₁₀ GLA47mm Ø Filter Ref 00983/75 Blast Furnace Cast House 03/03/2010
	TES Sample ID Number:	0015390
	Issue Date:	21 April, 2010
	Page:	15 of 25

Identification of Dust Gauge / Environmental Deposits by SEM-EDS Method Number SEMDG7

Forty particles were analysed individually; the results are shown below.

Category	Estimated %	Category	Estimated %
Carbonaceous matter	95	Animal/plant fragments	2
Calcium rich	3		
Mass of particulate on filter: 222 µg			

- 99% of particles present were <10µm in size.
- The examination procedure is based on an assessment of forty individual particles selected at random.
- The estimated percentage is based on a comparison of the relative number of particles counted in each category.
- TES Bretby does not accept responsibility for the sampling associated with the results reported above.
- Opinions and interpretations expressed herein are outside the scope of our UKAS accreditation.

Analysed &
Authorised by:



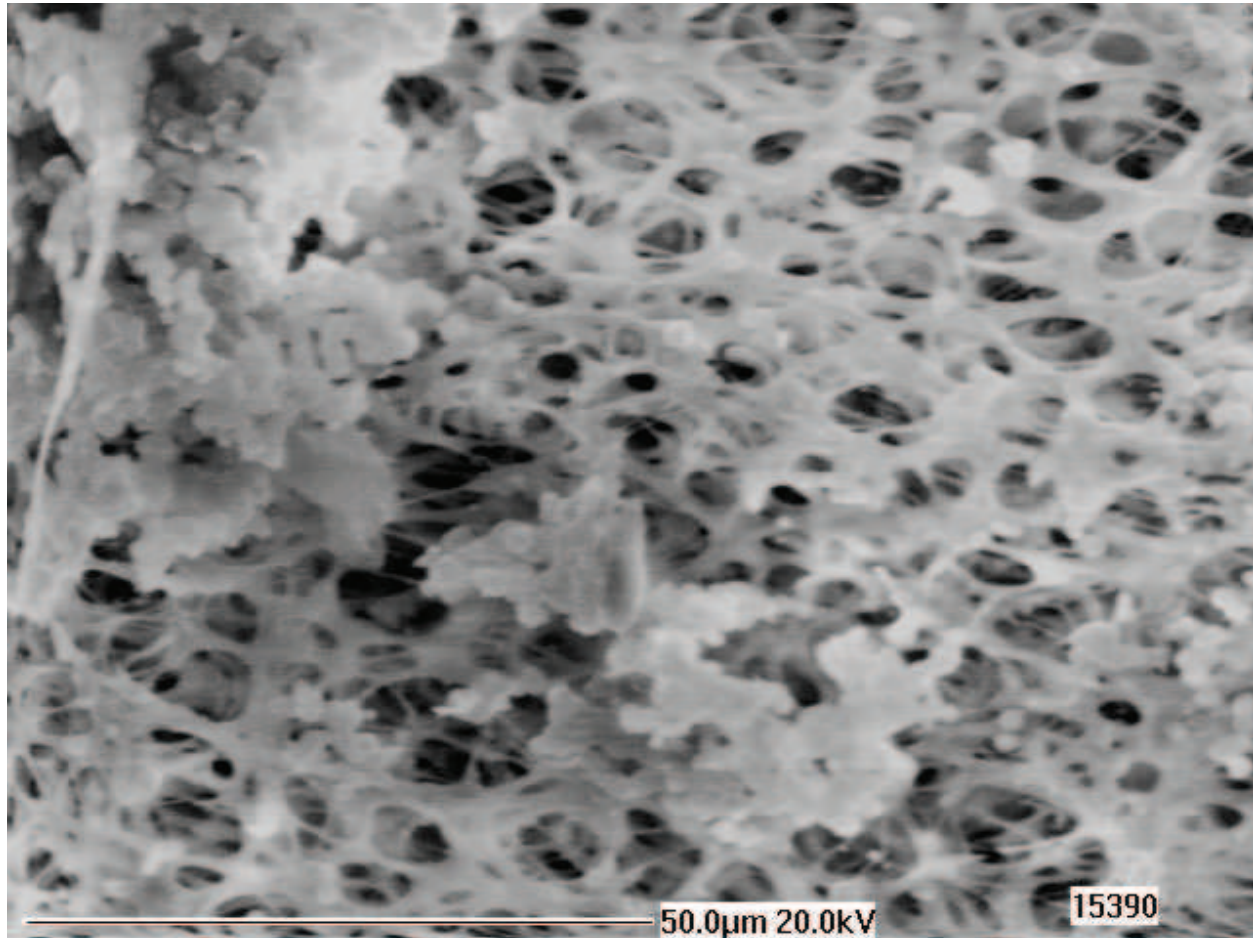
D A Cowper, SEM Senior Analyst
Direct Dial: 01283 554462

SEM-EDS Photomicrographs

Corus Steelworks – Blast Furnace Cast House

Filter ID 00983/75

Date Sample Taken – 03/03/2010



OCCUPATIONAL HYGIENE & ENVIRONMENTAL MONITORING LABORATORY

RESULTS OF EXAMINATION BY SEM-EDS

Ms R McCollom Environmental Scientist Wardell Armstrong LLP 2 The Avenue Leigh WN7 1ES	Report Number:	OHEM 02107/SEM/0001, Rev 0
	Job Number:	OHEM 02107
	Date Received:	10 March 2010
	Date Analysed:	19 March 2010
	Sample Description:	PM ₁₀ GLA47mm Ø Filter Ref 00983/33 BOS Plant Roof Space 04/03/2010
	TES Sample ID Number:	0015347
	Issue Date:	21 April, 2010
	Page:	1 of 25

Identification of Dust Gauge / Environmental Deposits by SEM-EDS Method Number SEMDG7

Forty particles were analysed individually; the results are shown below.

Category	Estimated %	Category	Estimated %	Category	Estimated %
Carbonaceous matter	63	Aluminium rich	5	Magnesium/silicon rich	2
Calcium/magnesium rich	13	Animal/Plant fragments	5	Aluminium/silicon/magnesium rich	2
Silicon rich	8	Iron rich	2		
Mass of particulate on filter: 286 µg					

- 99% of particles present were <10µm in size.
- The examination procedure is based on an assessment of forty individual particles selected at random.
- The estimated percentage is based on a comparison of the relative number of particles counted in each category.
- TES Bretby does not accept responsibility for the sampling associated with the results reported above.
- Opinions and interpretations expressed herein are outside the scope of our UKAS accreditation.

Analysed by: 
D Rayson, SEM Analyst

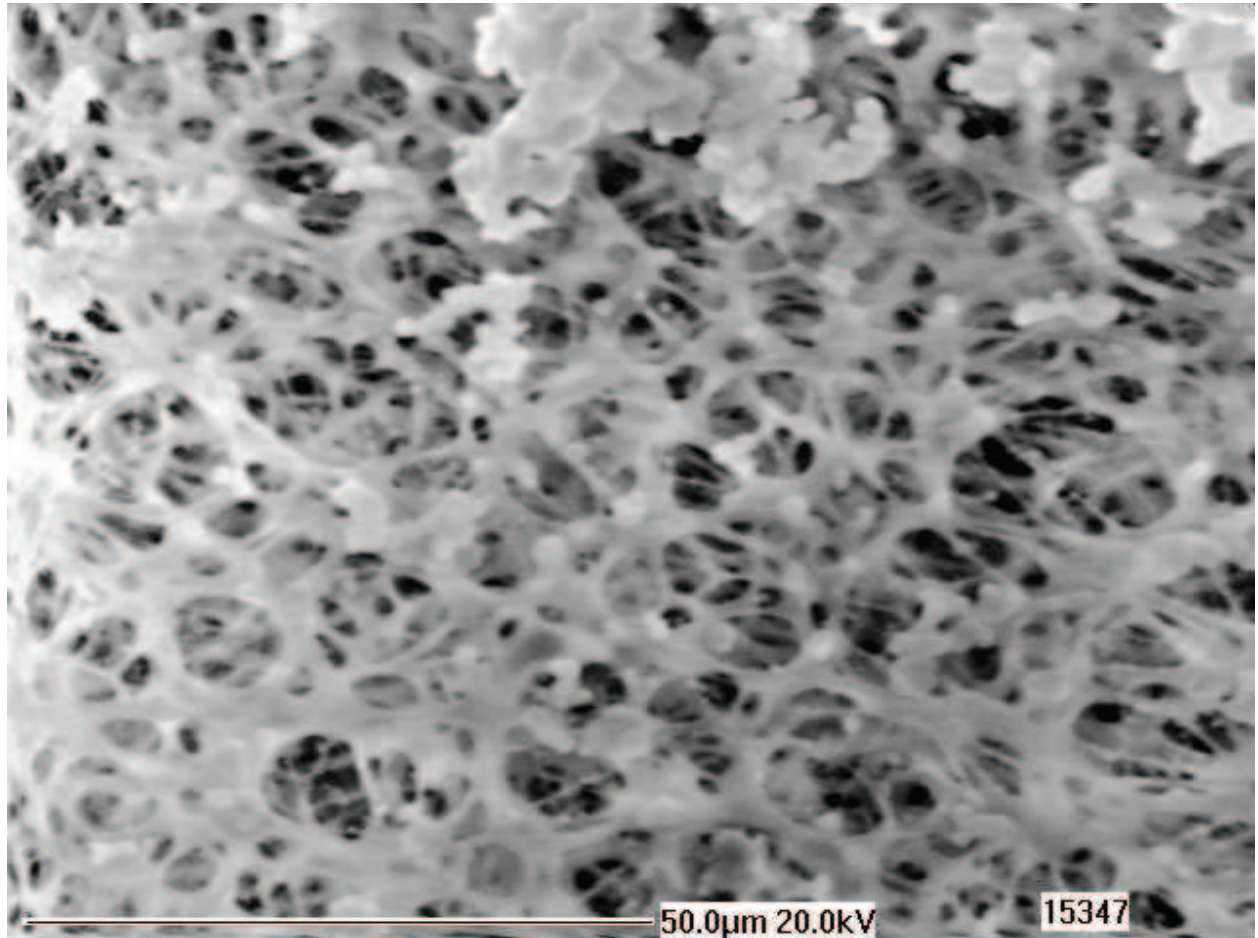
Authorised by: 
D A Cowper, SEM Senior Analyst
Direct Dial: 01283 554462

SEM-EDS Photomicrographs

Corus Steelworks – BOS Plant Roof Space

Filter ID 00983/33

Date Sample Taken – 04/03/2010



OCCUPATIONAL HYGIENE & ENVIRONMENTAL MONITORING LABORATORY

RESULTS OF EXAMINATION BY SEM-EDS

Ms R McCollom Environmental Scientist Wardell Armstrong LLP 2 The Avenue Leigh WN7 1ES	Report Number:	OHEM 02107/SEM/0001, Rev 0
	Job Number:	OHEM 02107
	Date Received:	10 March 2010
	Date Analysed:	19 March 2010
	Sample Description:	PM ₁₀ GLA47mm Ø Filter Ref 00983/36 BOS Plant Roof Space 04/03/2010
	TES Sample ID Number:	0015350
	Issue Date:	21 April, 2010
	Page:	2 of 25


Identification of Dust Gauge / Environmental Deposits by SEM-EDS Method Number SEMDG7

Forty particles were analysed individually; the results are shown below.

Category	Estimated %	Category	Estimated %	Category	Estimated %
Carbonaceous matter	58	Animal/Plant fragments	5	Aluminium/silicon/sodium/calcium rich	2
Calcium rich	13	Aluminium/silicon/calcium rich	3	Silicon/manganese	2
Calcium/magnesium rich	8	Aluminium/silicon/potassium rich	2		
Aluminium rich	5	Iron/manganese/magnesium rich	2		
Mass of particulate on filter: 131 µg					

- 99% of particles present were <10µm in size.
- The examination procedure is based on an assessment of forty individual particles selected at random.
- The estimated percentage is based on a comparison of the relative number of particles counted in each category.
- TES Bretby does not accept responsibility for the sampling associated with the results reported above.
- Opinions and interpretations expressed herein are outside the scope of our UKAS accreditation.

Analysed by:


D Rayson, SEM Analyst

Authorised by:

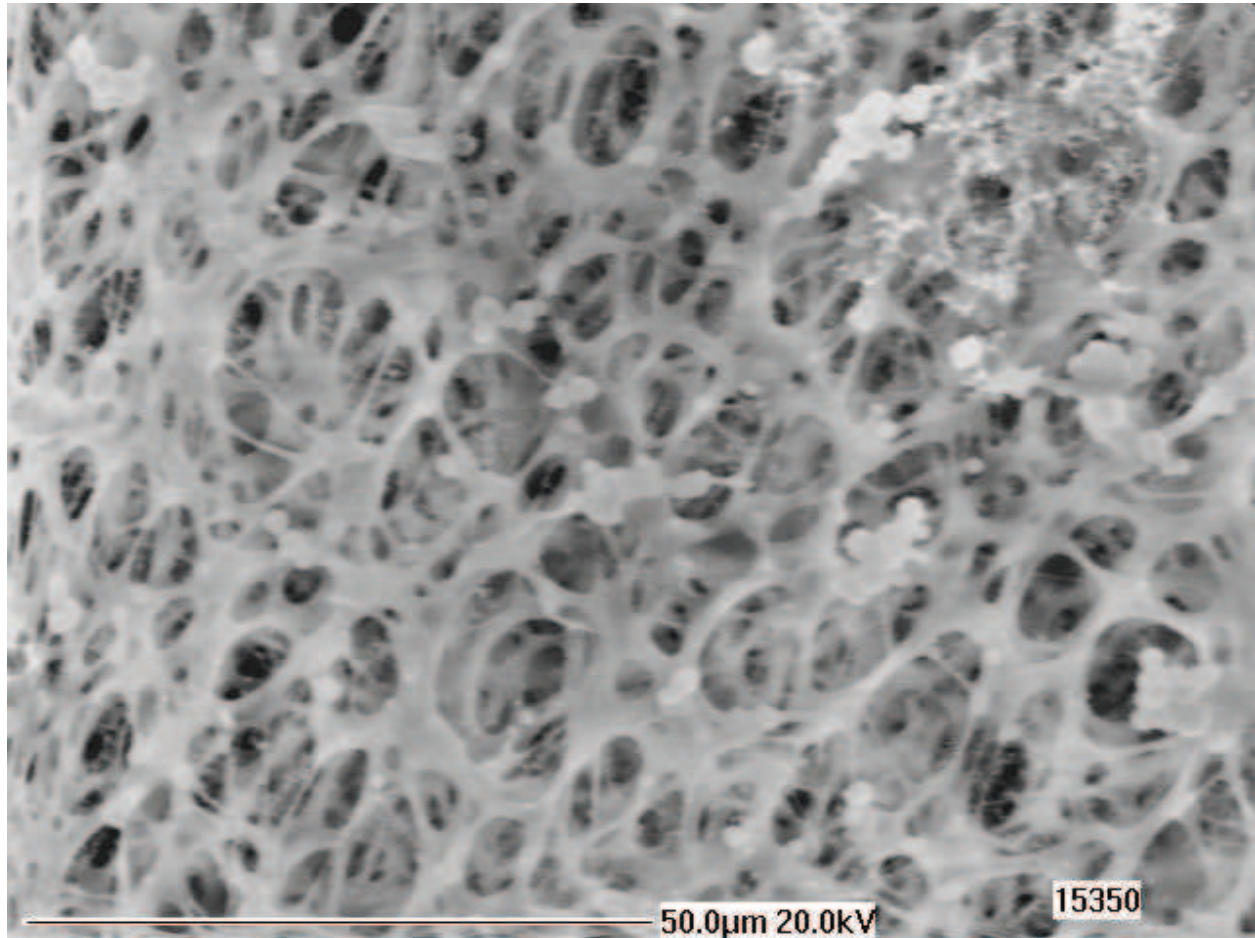

D A Cowper, SEM Senior Analyst
Direct Dial: 01283 554462

SEM-EDS Photomicrographs

Corus Steelworks – BOS Plant Roof Space

Filter ID 00983/36

Date Sample Taken – 04/03/2010



OCCUPATIONAL HYGIENE & ENVIRONMENTAL MONITORING LABORATORY

RESULTS OF EXAMINATION BY SEM-EDS

Ms R McCollom Environmental Scientist Wardell Armstrong LLP 2 The Avenue Leigh WN7 1ES	Report Number:	OHEM 02107/SEM/0001, Rev 0
	Job Number:	OHEM 02107
	Date Received:	10 March 2010
	Date Analysed:	22 March 2010
	Sample Description:	PM ₁₀ GLA47mm Filter Ø Ref 00983/44 BOS Plant Roof Space 05/03/2010
	TES Sample ID Number:	0015359
	Issue Date:	21 April, 2010
	Page:	5 of 25

Identification of Dust Gauge / Environmental Deposits by SEM-EDS Method Number SEMDG7

Forty particles were analysed individually; the results are shown below.

Category	Estimated %	Category	Estimated %	Category	Estimated %
Carbonaceous matter	18	Calcium rich	8	Iron/manganese rich	2
Magnesium/calcium rich	15	Calcium/sulphur rich	8	Silicon/Iron/manganese rich	2
Iron rich	13	Silicon/calcium rich	5	Zinc rich	2
Aluminium/silicon rich	10	Sodium/magnesium/ silicon/calcium rich	5		
Magnesium/aluminium/ silicon/calcium rich	10	Silicon rich	2		
Mass of particulate on filter: 285 µg					

- 99% of particles present were <10µm in size.
- The examination procedure is based on an assessment of forty individual particles selected at random.
- The estimated percentage is based on a comparison of the relative number of particles counted in each category.
- TES Bretby does not accept responsibility for the sampling associated with the results reported above.
- Opinions and interpretations expressed herein are outside the scope of our UKAS accreditation.

Analysed by:



D Rayson, SEM Analyst

Authorised by:



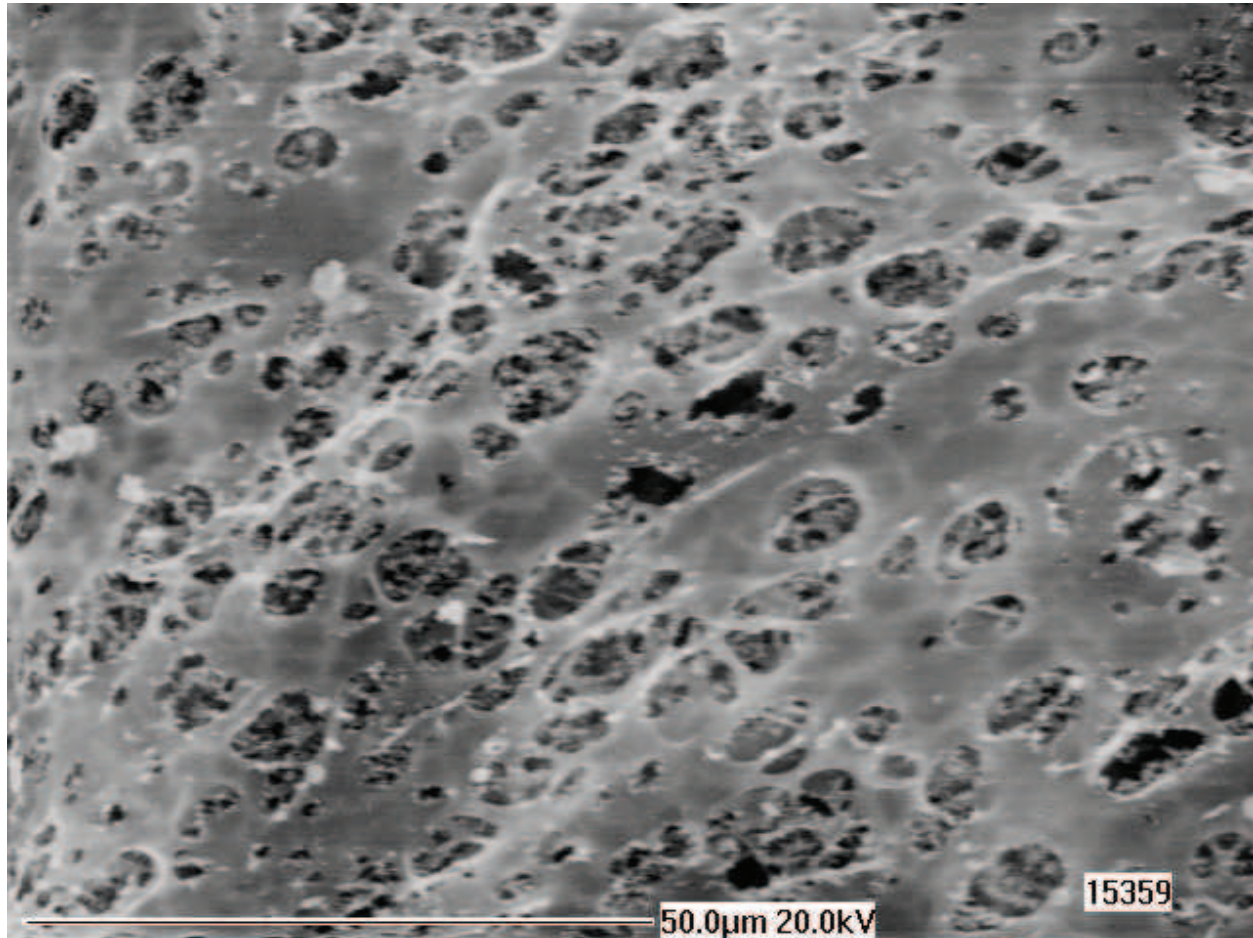
D A Cowper, SEM Senior Analyst
Direct Dial: 01283 554462

SEM-EDS Photomicrographs

Corus Steelworks – BOS Plant Roof Space

Filter ID 00983/44

Date Sample Taken – 04/03/2010



OCCUPATIONAL HYGIENE & ENVIRONMENTAL MONITORING LABORATORY

RESULTS OF EXAMINATION BY SEM-EDS

Ms R McCollom Environmental Scientist Wardell Armstrong LLP 2 The Avenue Leigh WN7 1ES	Report Number:	OHEM 02107/SEM/0001, Rev 0
	Job Number:	OHEM 02107
	Date Received:	10 March 2010
	Date Analysed:	22 March 2010
	Sample Description:	PM ₁₀ GLA47m Ø Filter Ref 00983/45 BOS Plant Roof Space 05/03/2010
	TES Sample ID Number:	0015356
	Issue Date:	21 April, 2010
	Page:	4 of 25


Identification of Dust Gauge / Environmental Deposits by SEM-EDS Method Number SEMDG7

Forty particles were analysed individually; the results are shown below.

Category	Estimated %	Category	Estimated %	Category	Estimated %
Carbonaceous matter	20	Animal/plant fragments	8	Sodium/sulphur rich	2
Calcium rich	20	Aluminium/ silicon/calcium rich	8	Calcium/iron/sulphur rich	2
Magnesium/aluminium/ silicon/calcium rich	15	Magnesium/calcium rich	8	Aluminium/silicon rich	2
Iron rich	10	Aluminium/ silicon/potassium rich	5		
Mass of particulate on filter: 149 µg					

- 100% of particles present were <10µm in size.
- The examination procedure is based on an assessment of forty individual particles selected at random.
- The estimated percentage is based on a comparison of the relative number of particles counted in each category.
- TES Bretby does not accept responsibility for the sampling associated with the results reported above.
- Opinions and interpretations expressed herein are outside the scope of our UKAS accreditation.

Analysed by:


D Rayson, SEM Analyst

Authorised by:

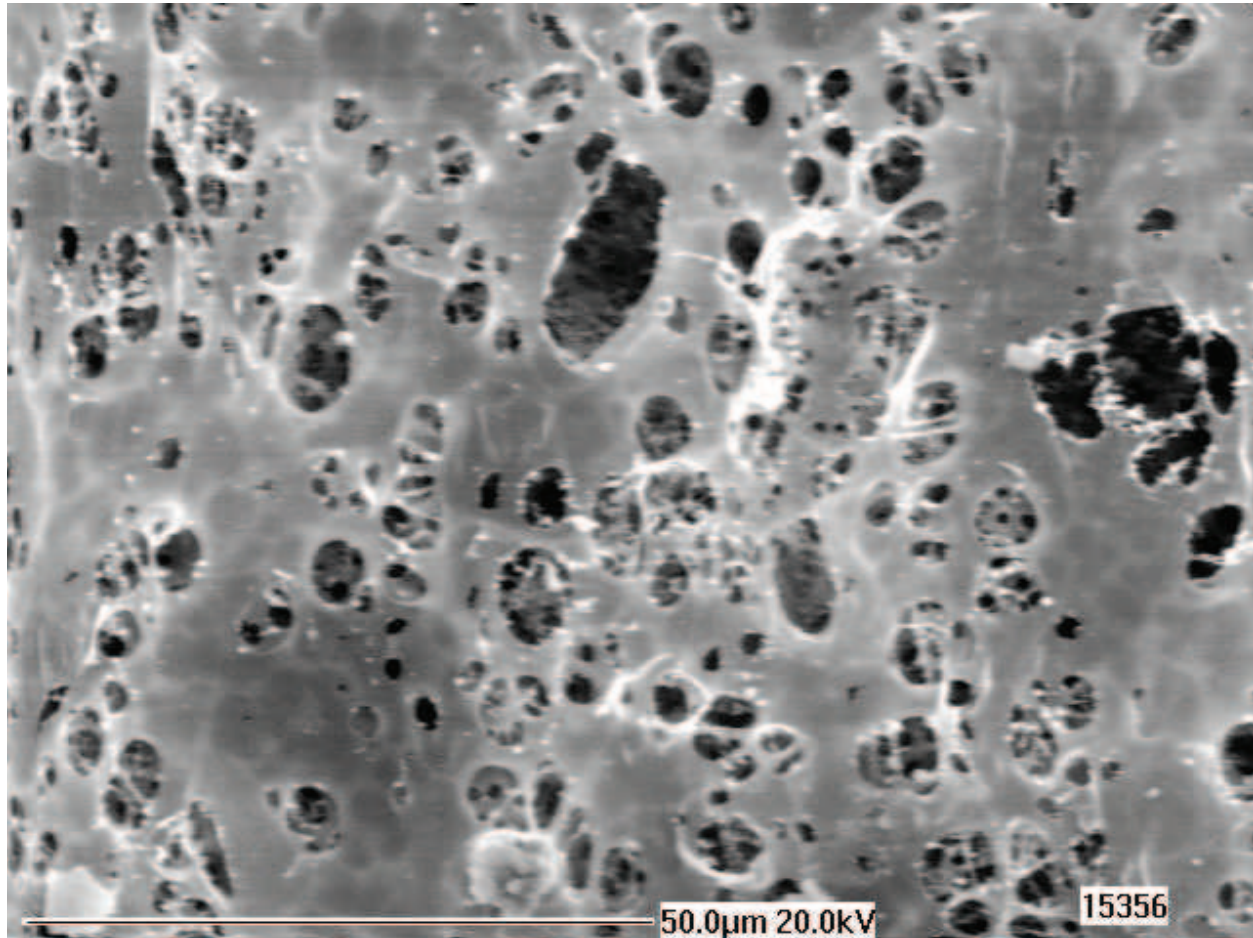

D A Cowper, SEM Senior Analyst
Direct Dial: 01283 554462

SEM-EDS Photomicrographs

Corus Steelworks – BOS Plant Roof Space

Filter ID 00983/45

Date Sample Taken – 05/03/2010



OCCUPATIONAL HYGIENE & ENVIRONMENTAL MONITORING LABORATORY

RESULTS OF EXAMINATION BY SEM-EDS

Ms R McCollom Environmental Scientist Wardell Armstrong LLP 2 The Avenue Leigh WN7 1ES	Report Number:	OHEM 02107/SEM/0001, Rev 0
	Job Number:	OHEM 02107
	Date Received:	10 March 2010
	Date Analysed:	19 March 2010
	Sample Description:	PM ₁₀ GLA47mm Ø Filter Ref 00983/58 BOS Plant Roof Space 05/03/2010
	TES Sample ID Number:	0015353
	Issue Date:	21 April, 2010
	Page:	3 of 25

Identification of Dust Gauge / Environmental Deposits by SEM-EDS Method Number SEMDG7

Forty particles were analysed individually; the results are shown below.

Category	Estimated %	Category	Estimated %	Category	Estimated %
Carbonaceous matter	63	Calcium rich	3	Potassium/sodium/calcium rich	2
Iron rich	18	Silicon rich	3	Silicon/sodium/calcium rich	2
Aluminium/silicon rich	5	Aluminium rich	2	Silicon/ calcium rich	2
Mass of particulate on filter: 211 µg					

- 99% of particles present were <10µm in size.
- The examination procedure is based on an assessment of forty individual particles selected at random.
- The estimated percentage is based on a comparison of the relative number of particles counted in each category.
- TES Bretby does not accept responsibility for the sampling associated with the results reported above.
- Opinions and interpretations expressed herein are outside the scope of our UKAS accreditation.

Analysed by: 
D Rayson, SEM Analyst

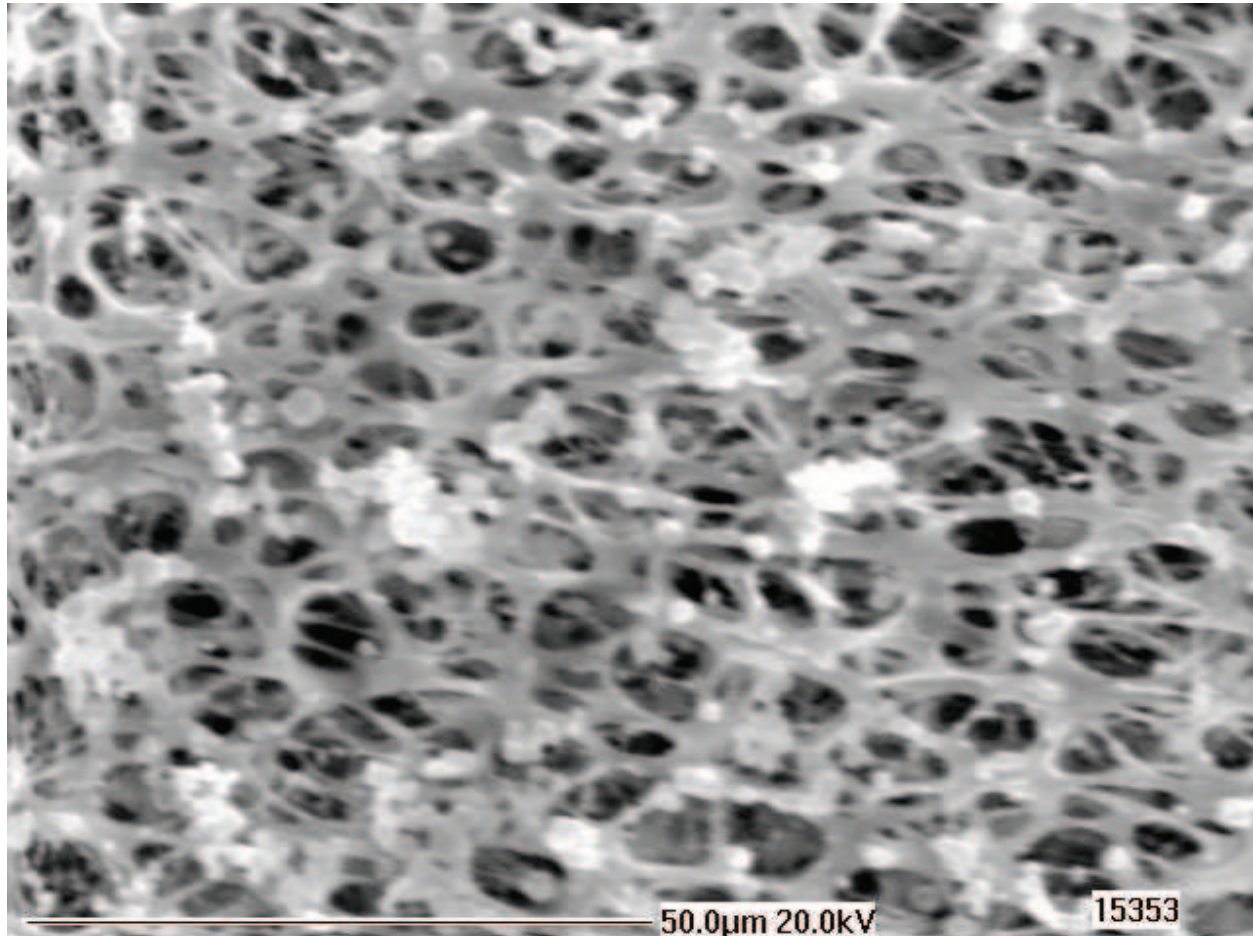
Authorised by: 
D A Cowper, SEM Senior Analyst
Direct Dial: 01283 554462

SEM-EDS Photomicrographs

Corus Steelworks – BOS Plant Roof Space

Filter ID 00983/58

Date Sample Taken – 05/03/2010



OCCUPATIONAL HYGIENE & ENVIRONMENTAL MONITORING LABORATORY

RESULTS OF EXAMINATION BY SEM-EDS

Ms R McCollom Environmental Scientist Wardell Armstrong LLP 2 The Avenue Leigh WN7 1ES	Report Number:	OHEM 02107/SEM/0001, Rev 0
	Job Number:	OHEM 02107
	Date Received:	10 March 2010
	Date Analysed:	26 March 2010
	Sample Description:	PM ₁₀ GLA47mm Ø Filter Ref 00983/48 Metal Recovery Plant (Multiserv) 03/03/2010
	TES Sample ID Number:	0015410
	Issue Date:	21 April, 2010
	Page:	21 of 25

Identification of Dust Gauge / Environmental Deposits by SEM-EDS Method Number SEMDG7

Forty particles were analysed individually; the results are shown below.

Category	Estimated %
Carbonaceous matter	97
Calcium rich	3
Mass of particulate on filter: 67 µg	

- 99% of particles present were <10µm in size.
- The examination procedure is based on an assessment of forty individual particles selected at random.
- The estimated percentage is based on a comparison of the relative number of particles counted in each category.
- TES Bretby does not accept responsibility for the sampling associated with the results reported above.
- Opinions and interpretations expressed herein are outside the scope of our UKAS accreditation.

Analysed &
Authorised by:



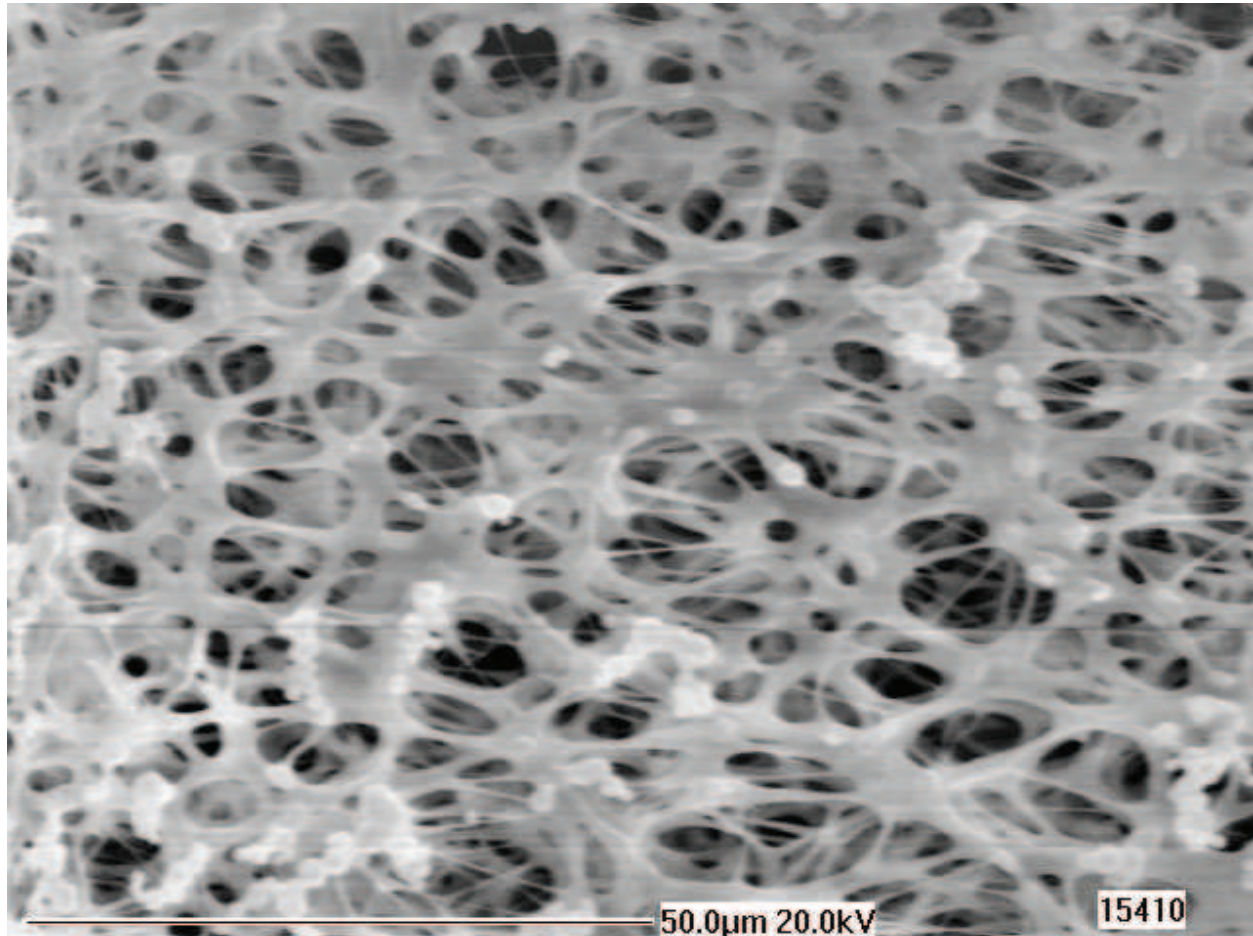
D A Cowper, SEM Senior Analyst
Direct Dial: 01283 554462

SEM-EDS Photomicrographs

Corus Steelworks – Metal Recovery Plant

Filter ID 00983/48

Date Sample Taken – 03/03/2010



OCCUPATIONAL HYGIENE & ENVIRONMENTAL MONITORING LABORATORY

RESULTS OF EXAMINATION BY SEM-EDS

Ms R McCollom Environmental Scientist Wardell Armstrong LLP 2 The Avenue Leigh WN7 1ES	Report Number:	OHEM 02107/SEM/0001, Rev 0
	Job Number:	OHEM 02107
	Date Received:	10 March 2010
	Date Analysed:	26 March 2010
	Sample Description:	PM ₁₀ GLA47mm Ø Filter Ref 00983/51 Metal Recovery Plant (Multiserv) 05/03/2010
	TES Sample ID Number:	0015416
	Issue Date:	21 April, 2010
	Page:	23 of 25

Identification of Dust Gauge / Environmental Deposits by SEM-EDS Method Number SEMDG7

Forty particles were analysed individually; the results are shown below.

Category	Estimated %	Category	Estimated %	Category	Estimated %
Carbonaceous matter	95	Iron rich	3	Calcium rich	2
Mass of particulate on filter: 121 µg					

- 100% of particles present were <10µm in size.
- The examination procedure is based on an assessment of forty individual particles selected at random.
- The estimated percentage is based on a comparison of the relative number of particles counted in each category.
- TES Bretby does not accept responsibility for the sampling associated with the results reported above.
- Opinions and interpretations expressed herein are outside the scope of our UKAS accreditation.

Analysed by:



D Rayson, SEM Analyst

Authorised by:



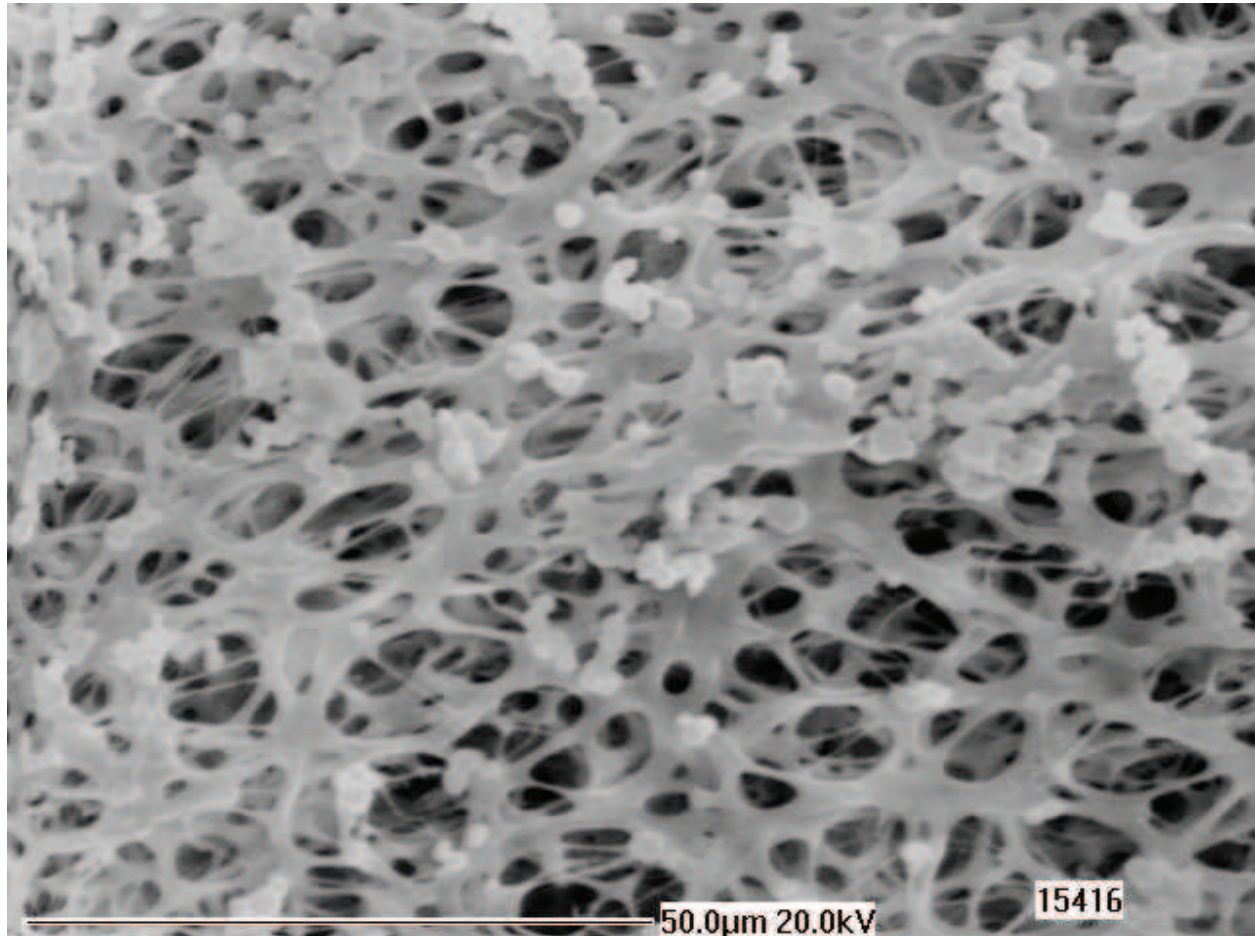
D A Cowper, SEM Senior Analyst
Direct Dial: 01283 554462

SEM-EDS Photomicrographs

Corus Steelworks – Metal Recovery Plant

Filter ID 00983/51

Date Sample Taken – 05/03/2010



OCCUPATIONAL HYGIENE & ENVIRONMENTAL MONITORING LABORATORY

RESULTS OF EXAMINATION BY SEM-EDS

Ms R McCollom Environmental Scientist Wardell Armstrong LLP 2 The Avenue Leigh WN7 1ES	Report Number:	OHEM 02107/SEM/0001, Rev 0
	Job Number:	OHEM 02107
	Date Received:	10 March 2010
	Date Analysed:	26 March 2010
	Sample Description:	PM ₁₀ GLA47mm Ø Filter Ref 00983/54 Metal Recovery Plant (Multiserv) 05/03/2010
	TES Sample ID Number:	0015425
	Issue Date:	21 April, 2010
	Page:	25 of 25

Identification of Dust Gauge / Environmental Deposits by SEM-EDS Method Number SEMDG7

Forty particles were analysed individually; the results are shown below.

Category	Estimated %	Category	Estimated %	Category	Estimated %
Carbonaceous matter	93	Animal/plant fragments	5	Aluminium/silicon/ potassium/iron rich	2
Mass of particulate on filter: 34 µg (QC Comment – filter torn)					

- 99% of particles present were <10µm in size.
- The examination procedure is based on an assessment of forty individual particles selected at random.
- The estimated percentage is based on a comparison of the relative number of particles counted in each category.
- TES Bretby does not accept responsibility for the sampling associated with the results reported above.
- Opinions and interpretations expressed herein are outside the scope of our UKAS accreditation.

Analysed by:



D Rayson, SEM Analyst

Authorised by:



D A Cowper, SEM Senior Analyst
Direct Dial: 01283 554462

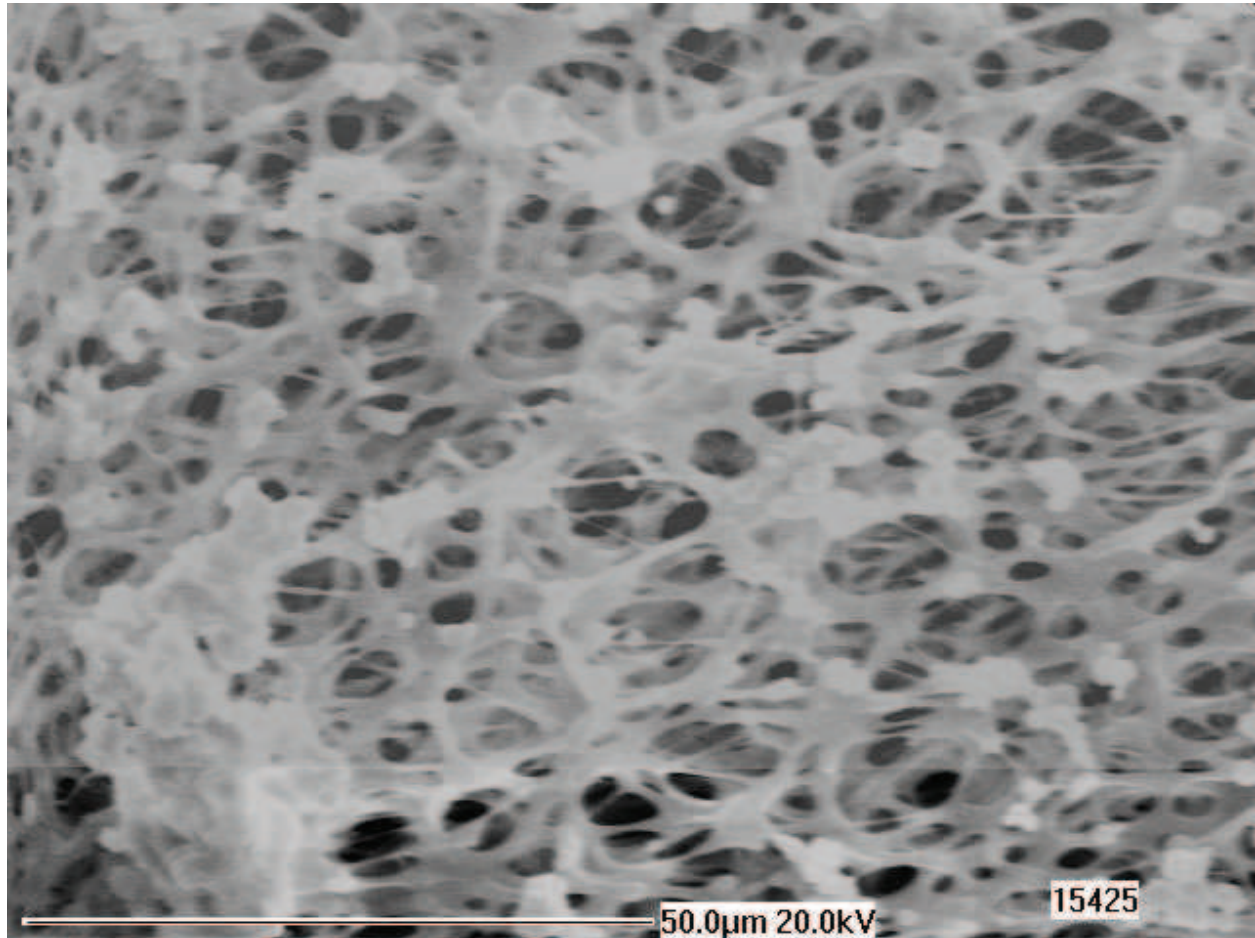
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SEM-EDS Photomicrographs

Corus Steelworks – Metal Recovery Plant

Filter ID 00983/54

Date Sample Taken – 05/03/2010



OCCUPATIONAL HYGIENE & ENVIRONMENTAL MONITORING LABORATORY

RESULTS OF EXAMINATION BY SEM-EDS

Ms R McCollom Environmental Scientist Wardell Armstrong LLP 2 The Avenue Leigh WN7 1ES	Report Number:	OHEM 02107/SEM/0001, Rev 0
	Job Number:	OHEM 02107
	Date Received:	10 March 2010
	Date Analysed:	26 March 2010
	Sample Description:	PM ₁₀ GLA47mm Ø Filter Ref 00983/57 Metal Recovery Plant (Multiserv) 05/03/2010
	TES Sample ID Number:	0015421
	Issue Date:	21 April, 2010
	Page:	24 of 25

Identification of Dust Gauge / Environmental Deposits by SEM-EDS Method Number SEMDG7

Forty particles were analysed individually; the results are shown below.

Category	Estimated %
Carbonaceous matter	98
Animal/plant fragments	2
Mass of particulate on filter: 27 µg	

- 100% of particles present were <10µm in size.
- The examination procedure is based on an assessment of forty individual particles selected at random.
- The estimated percentage is based on a comparison of the relative number of particles counted in each category.
- TES Bretby does not accept responsibility for the sampling associated with the results reported above.
- Opinions and interpretations expressed herein are outside the scope of our UKAS accreditation.

Analysed by: 
D Rayson, SEM Analyst

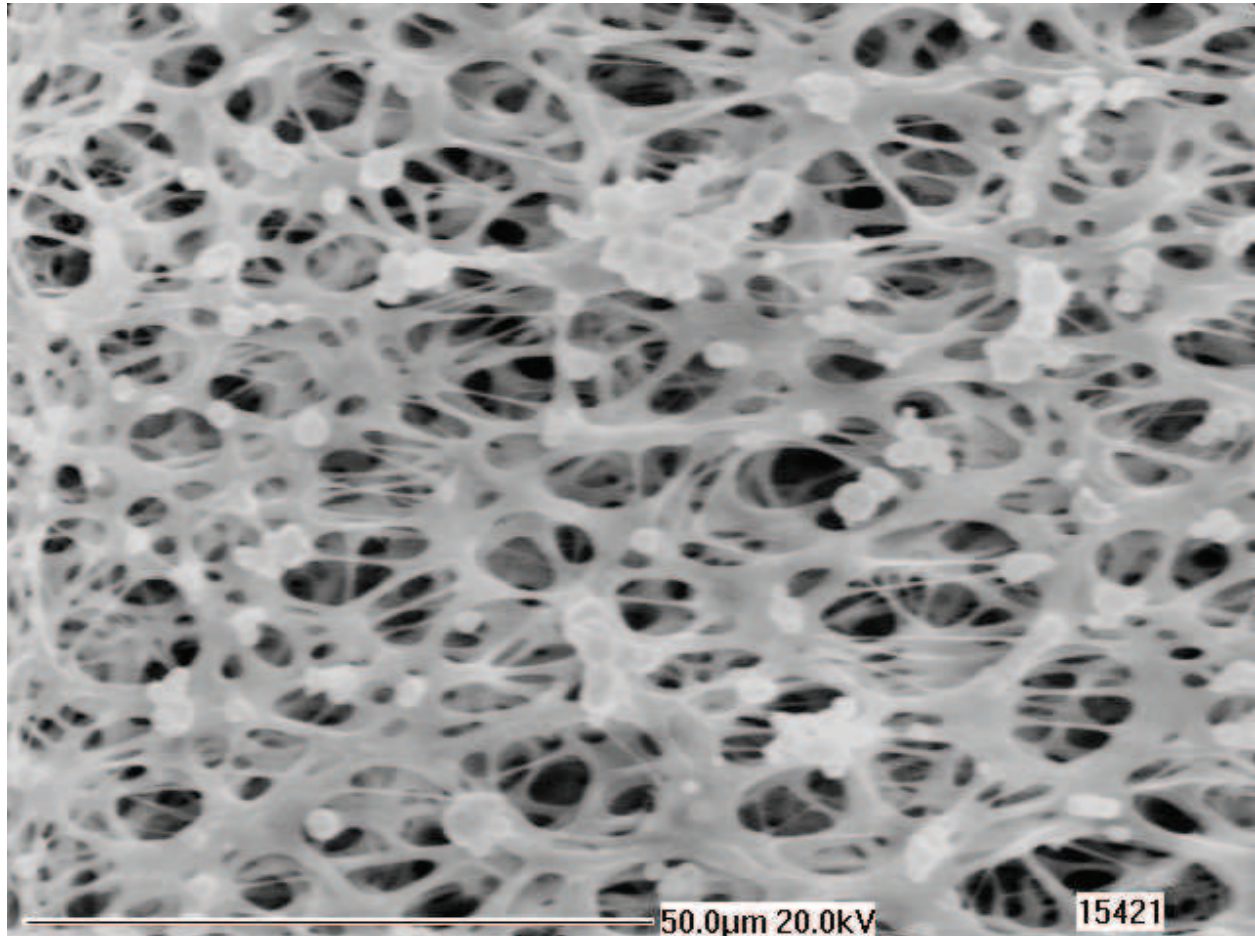
Authorised by: 
D A Cowper, SEM Senior Analyst
Direct Dial: 01283 554462

SEM-EDS Photomicrographs

Corus Steelworks – Metal Recovery Plant

Filter ID 00983/57

Date Sample Taken – 05/03/2010



OCCUPATIONAL HYGIENE & ENVIRONMENTAL MONITORING LABORATORY

RESULTS OF EXAMINATION BY SEM-EDS

Ms R McCollom Environmental Scientist Wardell Armstrong LLP 2 The Avenue Leigh WN7 1ES	Report Number:	OHEM 02107/SEM/0001, Rev 0
	Job Number:	OHEM 02107
	Date Received:	10 March 2010
	Date Analysed:	25 March 2010
	Sample Description:	PM ₁₀ GLA47mm Ø Filter Ref 00983/41 Slag Processing Area 05/03/2010
	TES Sample ID Number:	0015413
	Issue Date:	21 April, 2010
	Page:	22 of 25

Identification of Dust Gauge / Environmental Deposits by SEM-EDS Method Number SEMDG7

Forty particles were analysed individually; the results are shown below.

Category	Estimated %	Category	Estimated %	Category	Estimated %
Carbonaceous matter	50	Calcium/silicon rich	15	Iron rich	5
Calcium rich	18	Animal/plant fragments	10	Calcium/magnesium rich	2
Mass of particulate on filter: 100 µg					

- 99% of particles present were <10µm in size.
- The examination procedure is based on an assessment of forty individual particles selected at random.
- The estimated percentage is based on a comparison of the relative number of particles counted in each category.
- TES Bretby does not accept responsibility for the sampling associated with the results reported above.
- Opinions and interpretations expressed herein are outside the scope of our UKAS accreditation.

Analysed &
Authorised by:



D A Cowper, SEM Senior Analyst
Direct Dial: 01283 554462

SEM-EDS Photomicrographs

Corus Steelworks – Slag Processing Area

Filter ID 00983/41

Date Sample Taken – 05/03/2010

