REC
Resource & Environmental Consultants Ltd

MONITORING OF EMISSIONS FROM THE FURNACE, ACID SCRUBBER & WET ARRESTOR PROCESSES

21 February, 2014

Prepared for Staffordshire Crystal Ltd

REC Report 71621p2r0

Issued: 5 March 2014

REC Air Quality

GREEN ACHIEVER™

SAFEcontractor APPROVED

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EXECUTIVE SUMMARY

Resource & Environmental Consultants (REC) Ltd was commissioned by Staffordshire Crystal Ltd to monitor emissions of pollutants released from the Acid Scrubber process at their site in Brierley Hill.

In accordance with the requirements of their site permit, monitoring has been undertaken for the following pollutants:-

- Hydrogen Fluoride

The following results were obtained from the monitoring survey and are compared with the current permit limit:-

Emission Source	Species	Emission Concentration (mg/m^3)	Permit Limit (mg/m^3)
Acid Scrubber Run 1	Hydrogen Fluoride	1.6	5

NOTE 1: ACID SCRUBBER EMISSION DATA EXPRESSED IN MG/M^3 AT 273K, 101.3KPA, WITHOUT CORRECTION FOR MOISTURE AND OXYGEN CONTENT.

INTRODUCTION

1.1 Background

Staffordshire Crystal Ltd commissioned REC Ltd to conduct an emission monitoring survey on the Acid scrubber process at their site in Brierley Hill.

The Acid Fume Scrubbing Unit process collects the exhaust gases arising from the glass cleaning process which pass through a wet scrubber before being discharged to the atmosphere.

1.2 Scope of the Survey

An emission monitoring survey was required to determine the release concentrations of various pollutants from the Acid Scrubber processes. Concentrations of the following pollutants were quantified during the survey:

- Hydrogen Fluoride

Ancillary measurements of stack dimensions, temperature and velocity were also made.

The results are reported at 273K, 101.3kPa, without correction for moisture and oxygen content

1.3 Sampling Personnel

Monitoring was conducted by the following REC Ltd permanent staff:-

- Dave Burns - Team Leader, MM05 579, MCERTS Level 2, TE 1 - 4
- Michelle Edwards - Assistant, MM05 659, MCERTS Level 2, TE 1 - 3

2. METHODOLOGY

2.1 Species & Techniques

The following table shows the reference methods used for the emission monitoring survey:

Species	Method	Uncertainty (±%)	Limit of Detection
Moisture	In house method MM0010 based on BS EN 14790	20	0.1%vol
Hydrogen Fluoride	In house method MM0013 based on BS ISO 15713	20	0.1 mg/m^3

2.2 Sampling & Analytical Methodology

Hydrogen Fluoride

To determine the concentration of HF in emissions, non isokinetic stack sampling equipment based on the requirements of BS ISO 15713 was utilised and in-house method MM00013 followed.

A sample of the exhaust stream was removed from the stack via a PTFE probe.

On leaving the probe, the sampled exhaust gas was passed into a series of Impingers. The first two Impingers encountered by the gas stream contained dilute Sodium Hydroxide (0.1M) to capture and absorb the volatile fluoride (F^-) ions. The third Impinger was empty and the fourth contained anhydrous silica gel which was used to dry the gas stream before passing it through a dry gas meter (DGM) to measure the volume of gas sampled.

Upon completion of sampling, the contents of the first two Impingers were transferred to a sealed, labelled container, which was subsequently analysed for F^- via an ion chromatographic technique.

3. SAMPLING AND OPERATIONAL DETAILS

3.1 Process Description

The operations at Staffordshire Crystal are authorised under a Part B permit issued by the Local Authority under the Environmental Permitting Regulations, 2010.

The process is therefore under Local Authority regulation and must demonstrate compliance with the emission limits stipulated in the site permit: PB/98/CP1

The Acid Fume Scrubbing Unit utilises a wet scrubber in order to minimise hydrogen fluoride emissions which are collected from the acid polishing process inside the factory. The loading during testing was normal.

3.2 Sampling Positions

On the Acid Fume Scrubbing Unit a 1 x 1 inch hole was installed in a vertical section of ducting. The sampling plane was greater than five hydraulic diameters both upstream and downstream away from potential flow disturbances. The size of the port does not comply with the requirements specified in the EA technical guidance note M1.The velocity profile conducted along sampling plane complies with the requirements of the EA technical guidance not M1.

3.3 Uncertainty

On the Acid Fume Scrubbing Unit only one port was installed, however this will not affect the standard uncertainty associated with the HF testing as the HF was sampled in the gaseous phase and so it is assumed to be homogenous across the sample plane. Consequently standard uncertainties apply.

3.4 Emission Monitoring Survey Details

The emission monitoring survey was carried out on at Staffordshire Crystal Ltd on the 21 February 2014. The table below summarises the actual sampling periods.

SAMPLING PERIODS

Stack	Parameter	Sample Time (& Date)
Acid Fume Scrubbing Unit	Hydrogen Fluoride	09:44 – 10:44 (21/02/14)

4. RESULTS AND DISCUSSION

4.1 Initial Velocity and Temperature Traverse

An initial pitot-static pressure and temperature traverse was carried out. From these data stack velocity, expressed in metres per second (m/s), and volumetric flowrates expressed in cubic metre per hour (m^3/hr) have been calculated.

The results are reported at actual stack conditions and the volumetric flowrate is further expressed at the standard reference conditions of 273K, 101.3kPa i.e. standard temperature and pressure (STP). The results are summarised in Table 1.

4.2 Hydrogen Fluoride

The results of the volatile fluoride sampling run is summarised in Table 6. From the concentration of F^- and the measured volume of absorbing solution a total mass of HF in microgram (µg) was determined. From the respective molecular weight, equivalent weights of HF were then calculated. From the measured sample volume, an emission concentration was calculated.

The results are expressed in mg/m^3 at 273K, 101.3kPa, without correction for water vapour and oxygen content.

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TABLES

TABLE 1

FLOW DATA

Stack Ref.	Stack Temp	Av Pitot ΔP	Duct Diam	X-Sect. Area	Velocity (actual)	Volume Flow (m^3/hr)	
	(^{0}C)	(Pa)	(cm)	(m^2)	(m/s)	(actual)	(@ ntp)
Acid Scrubber	10	81	50	0.196	11.4	8,054	7,783

TABLE 2

HYDROGEN FLUORIDE EMISSION DATA SUMMARY– ACID SCRUBBER

Sampling Data	**Run 1**
Start Time/Date	09:44, 21/02/14
End Time/Date	10:44, 21/02/14
Sampling Period (min)	60
DGM start (dry m^3)	55.757
DGM end (dry m^3)	56.245
Volume Sampled (dry m^3)	0.488
Ambient Temp (^oC)	3
Ambient Press (kPa)	98.4
Wt of Water (g)	10.1
Volume Water (m^3)	0.013
Volume Sampled, 273K, 101.3kPa (dry m^3)	0.469
Volume Sampled, 273K, 101.3kPa (wet m^3)	0.481
Volume NaOH Impingers (ml)	450
Analytical Data	
HF Blank (mg/l)	<0.05
HF in NaOH Imps (mg/l)	1.70
HF (µg)	765
Emission Concentration Data	
Moisture (%vol)	2.6
HF (mg/m^3)	1.6
HF Measurement Uncertainty (± mg/m^3)	0.2

APPENDIX 1

Calculations

Conversion Factors

ppm ® mg/Nm³ (at 273K, 101.3kPa: STP)

CO	x	1.25	
SO_2	x	2.86	
VOC's	x	1.61	(ppm as C_3H_8 to mg/Nm^3 as C)
NO_X	x	2.05	(ppm NO + NO_2 to mg/m^3 as NO_2)

Oxygen Correction to Reference Value

Concentration at (STP) -> Concentration at 273K, 101.3kPa, reference O_2 and Dry Gas, i.e.

Concentration X ((20.9-O_2 ref)/(20.9-O_2 measured)) = Concentration at ref Oxygen state.

Example Calculation

SO_2 concentration at STP	=	170.7 mg/Nm³
Oxygen percentage in gas stream	=	13.8%
Reference Oxygen	=	11%
SO_2 concentration at reference O_2 conditions	=	170.7 ((20.9-11)/(20.9-13.8))
	=	238 mg/Nm³ at 273K, 101.3kPa, 11% O_2 and Dry Gas

Moisture Correction (Wet to Dry)

Concentration of Gas Dry = Concentration of x 100/100-Bws Gas Wet

Concentration of Gas Wet = Concentration of x 100-Bws/100 Gas Dry

Where Bws = moisture content of gas stream in percent (Vol/Vol).

Example

VOC concentration	=	25 mg/Nm³ (Wet)
Moisture Content	=	27.1%
Concentration of VOC	=	25 (100/(100-27.1))

Carbon (C) to Trichloethylene (TCE)

ppm TCE = ppm C x 0.6715

TCE in mg/m^3 = TCE ppm x 5.864 (Mol Wt/22.4)