

Íslenska Kalkpörungafélagið

Measurements of Suspended Particulate Matter (SPM) in Exhaust Ducts



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Report title:

MEASUREMENTS OF PARTICLES IN EXHAUST DUCT

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Abstract:

Measurements of suspended particulate matter (SPM) from the exhaust ducts in the plant of the Íslenska kalkþörungafélagið where carried out on September 6th, 2022 by Verkís Ltd.

The following factors were measured: Total amount of suspended particulate matter (SPM), flue gas velocity and flue gas temperature.

The particulate content in the old stack (outside) was found to be 23 mg/Nm³.

The particulate content in the new stack (inside) was found to be 7 mg/Nm³.

Only two sampling runs were possible in each duct due to time constraints.

Keywords (English):

Sampling of particulate matter, duct exhaust measurements

Keywords (Icelandic):

Rykmælingar, útblástursmælingar

Project manager´s signature:

Reviewed by:
BTA

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1 Introduction

Exhaust duct sampling at Íslenska Kalkþörungafélagið were carried out on September 6th by Verkís staff. Measured factors were suspended particulates, air velocity, flow volume and temperature.

2. Measurement and sampling

All measurements are carried out according to the International Standards ISO 10780 and EN-3284. Air velocity flowing through the duct is measured with a velocity meter consisting of an inclined manometer and pitot tube. The number of traverse points for measuring velocity are dictated by the dimension of the ducts, in this case 0.66 m in the outside stack and 0.60 m in the inside stack. The velocity measurements are then used to calculate the flow required to maintain isokinetic conditions. Isokinetic conditions are achieved by maintaining the velocity at the nozzle equivalent to the velocity of the flue gas in the duct. Under these conditions a representative sample of the particles flowing in the stack can be gained. The diameter of the nozzle used in the exhaust duct from the plant was 4.8 mm for the outside stack and 6.4 mm for the inside stack. Duct gas temperature is measured with a thermocouple.

The sampling process:

In principle the flue gas enters the sampling train system through a nozzle on the tip of the sampling probe, passes through the filter where suspended particulate matter (SPM) is removed and reaches the sampling train/condenser assembly in the cold box section. Here the gases cool down and bubble through impingers consisting of silica gel and distilled water. After passing through the impingers the gas is drawn through the vacuum pump and exhausted into the atmosphere.

Standards and equipment:

The equipment consists of Apex XD-502 console for isokinetic dust sampling, along with necessary equipment as a pitot tube, and a thermocouple. The filters used are of glass fibre type. They are dried and weighted prior to use and then dried and weighted again. The weight difference is the amount of dust collected in the sampling. The volume of sampled air is calculated to standard conditions, STP, (273 K, 101.3 kPa).

Due to a narrow time frame, only two sampling runs could be made for each of the stacks.

3. Results

The results of the measurements are shown in the tables below.

Velocity measurements and source sampling was done in 12 points in the sampling plane according to the standards ISO 10780 and EN 13284¹, see layout of duct below:

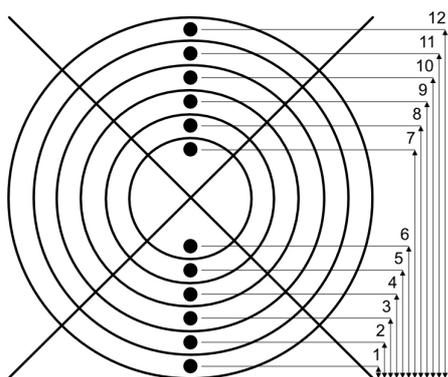


Table 3.1 Duct Size Parameters of outside stack

Duct	Value	Unit
Duct Inside Diameter	≈0.66	m
Duct Area	≈0.34	m ²

Table 3.2 Results of sampling in outside stack

Exhaust Measurements		
Parameter	Measured (Average)	Discharge
SPM Measured	22 mg/Nm ³	0.57 kg/klst
Air Velocity	19.03 m/s	-
Flow Volume (Actual)	24,780 m ³ /klst	-
Atmospheric Pressure at Metering Point	841.8 mmHg	
Temperature of Exhaust in Air Duct	32.5°C	-
Temperature at Metering Point	20.9°C	-

¹ At the inside stack, only one measuring port could be used. This is a deviation from the ISO 13284 standard.

Table 3.3 Lab Results for the outside stack

SPM				
Sample Run	Measured	Filter #	Time	Discharge
Sample 1	14.8 mg	22-10748 + 22-10751	16:55-17:25	0.56 kg/klst
Sample 2	15.7 mg	22-10754 + 22-10756	17:46-18:16	0.61 kg/klst
Blank	3.6 mg	22-10746	18:36-18:51	-

Table 3.1 Duct Size Parameters of the inside stack

Duct	Value	Unit
Duct Inside Diameter	≈0.60	m
Duct Area	≈0.28	m ²

Table 3.2 Results of sampling in the inside stack

Exhaust Measurements		
Parameter	Measured (Average)	Discharge
SPM Measured	7 mg/Nm ³	0.08 kg/klst
Air Velocity	12.19 m/s	-
Flow Volume (Actual)	12,180 m ³ /klst	-
Atmospheric Pressure at Metering Point	842.5 mmHg	-
Temperature of Exhaust in Air Duct	47.1°C	-
Temperature at Metering Point	26.4°C	-

Table 3.3 Lab Results for the inside stack

SPM				
Sample Run	Measured	Filter #	Time	Discharge
Sample 1	5.7 mg	22-10749 + 22-10751	21:39-22:09	0.11 kg/klst
Sample 2	3.6 mg	22-10754 + 22-10757	22:36-23:06	0.07 kg/klst
Blank	7.3 mg	22-10747 + 22-10748	23:30-23:45	-

High, negative pressure at the sampling port (-164 mm Hg) may affect the blank sample.

4. References

1. ISO 10780 International Standard – Stationary Source Emissions – Measurement of velocity and flow rate of gas streams in ducts
2. EN 13284 Stationary source emissions-Determination of low range mass concentration of dust-Part 1: Part 1: Manual gravimetric method

5. Lab Report



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Skýrsla nr.: 22483-22
Gerð sýnis: Umhverfissýni
Dags. beiðni: 7.9.2022
Dags. rannsóknar: 28.9.2022
Sýnataka: Verkís hf.
Tengiliður: Birgir Tómas Arnar
Starfsstöð: Birgir Tómas Arnar - Ofanleiti 2

Sýni nr.	Mæling	Niðurstöður	Mælieining	Aðferð
22-10746	Ryksía - Úti BG			
	Purrkun og vigtun á ryksíum	3,6	/ mg	
22-10747	Ryksía - Inni BG			
	Purrkun og vigtun á ryksíum	< 0,1	/ mg	
22-10748	Skol - Inni BG			
	Purrkun og vigtun á ryksíum	7,3	/ mg	
22-10749	Ryksía - Úti R1			
	Purrkun og vigtun á ryksíum	14,8	/ mg	
22-10750	Ryksía - Inni R1			
	Purrkun og vigtun á ryksíum	4,7	/ mg	
22-10751	Skol - Úti R1			
	Purrkun og vigtun á ryksíum	0,1	/ mg	
22-10752	Skol - Inni R1			
	Purrkun og vigtun á ryksíum	1,0	/ mg	
22-10754	Ryksía - Úti R2			
	Purrkun og vigtun á ryksíum	15,7	/ mg	
22-10755	Ryksía - Inni R2			
	Purrkun og vigtun á ryksíum	3,6	/ mg	
22-10756	Skol - Úti R2			
	Purrkun og vigtun á ryksíum	< 0,1	/ mg	
22-10757	Skol - Inni R2			
	Purrkun og vigtun á ryksíum	< 0,1	/ mg	

Kópavogur, 29.9.2022

Þetta er prófunarskýrsla sem hefur verið yfirfarin og samþykkt á rafrænan hátt. Skýrslan er gild án undirskriftar

Magnús Snær Árnason
Sérfræðingur