



June 17, 2019

Ms. Karen Kajiya-Mills
Michigan Department of Environment, Great Lakes, and Energy
Air Quality Division
525 West Allegan Street
Lansing, MI 48909



Re: Post Consumer Brands (B1548):
Volatile Organic Compound (VOC) Emissions Testing of FG2983CoatOxdOn

Dear Ms. Mills:

Post Consumer Brands (PCB) completed VOC emissions testing on its coating reel process (EU 2983) and associated drying equipment controlled by a catalytic oxidizer (FG2983CoatOxdOn) on April 17, 2019, as required by our renewable operating permit No. MI-ROP-B1548-2014d (ROP). Upon receiving a copy of the draft report, PCB noted that emissions from the inlet to the wet rotoclone collector were less than emissions from the outlet of the wet rotoclone collector, as described on pages 12 to 14 of the test reported (attached) and these concerns were noted in the report.

Upon further review of the laboratory report for USEPA Method 8015 that was run by Pace Analytical to determine the ethanol content in the flavor used during the test, PCB noted that the two flavor sample results used to develop uncontrolled ethanol emission rates for EU2983 seemed oddly dissimilar considering the results were for the same flavor taken from the same drum of material. In reading the laboratory report (Attachment 1) in more detail, it was noted that the samples were not kept below 6°C prior to receipt at the laboratory (a condition required by the test method). Samples were received at the laboratory at 17.6°C (see attached). The samples were the same flavor and should have had nearly identical results for ethanol content, but the laboratory report indicated that one sample contained 480,000 parts per million (ppm), while the other contained 622,000 ppm ethanol. Only two samples were taken and used to establish the uncontrolled emission rate of 40.5 pounds per hour (lb/hr) used for each of the three test runs.

As mentioned briefly above, the emissions information collected on the wet rotoclone does not make any sense. The wet rotoclone collector is a piece of air pollution control equipment and should reduce emissions, not increase them. PCB cannot find any reasonable explanation for the increase in emissions that is shown from operating the wet rotoclone collector and has, therefore, rejected the emissions information included in this report. Wastewater discharged from the wet rotoclone collector has been analyzed and suggests that at least 6 percent of the ethanol emitted during the coating process is collected within the wet rotoclone and discharged to the wastewater collection system. At this time, we can only assume that some mix-up occurred with the data and have scheduled a retest for August 2019.

Because of the above errors, the VOC control efficiency of 85.5 percent (combined capture and destruction efficiency) was not met. It should be noted that FG2983CoatOxdOn is limited to 25.6 tons per year (tpy), and even though the results indicate that VOC control efficiency is less than 85.5 percent, total emissions from the process are under the annual limit were the process to operate at the allowed 8160 hr/yr¹. It should be noted that information on the ethanol samples was not used in calculating VOC emissions from the catalytic oxidizer.

¹ 4.9 lb/hr x 8160 hr/yr x ton/2000 lb = 19.99 tpy, less than the 25.6 tpy limit

June 14, 2019

While the questionable emissions data from operating the wet rotoclone dust collector is of greatest concern, PCB has identified other smaller sources of error in the testing that led to reporting excess emissions. These include:

- Ethane in the natural gas or formed as a product of incomplete combustion is reported as VOCs using USEPA Reference Method 25a.
- Errors introduced when it was assumed that VOCs leaving the catalytic oxidation unit are ethanol and requiring use of a response factor. While all of the VOCs entering the catalytic oxidation unit are ethanol, it is likely that the majority of hydrocarbons leaving the catalytic oxidation unit are not ethanol, but products of incomplete combustion. These emissions were overestimated when multiplied by 1.65.
- Only two flavor samples (over the three test runs) were taken to determine ethanol loading into the system. Additional samples will likely lead to a more accurate calculation of emissions from the process.

To ensure more accurate emissions data during the next stack test scheduled for August 2019, PCB will take additional flavor samples (two per test run) and ensure samples are collected and handled as required by the test method. In addition, PCB has also engaged both its environmental consultant and the test firm to review the test and determine if additional testing (like use of FTIR) would improve results.

It should also be noted that after the catastrophic fan failure on the catalytic oxidizer last year, PCB replaced the entire fan wheel, shaft, and bearings. PCB has a comprehensive preventative maintenance program for the catalytic oxidizer system and has completed the following preventive and corrective actions during the last year:

- PCB retained full spare catalytic oxidizer fan wheel, shaft, and bearings. Replaced heat exchanger in July 2018.
- Hired a consultant to analyze the entire system on an annual basis (begin in 2018 and completed again in 2019).
- Replaced both banks of catalyst between July and September 2018.
- Installed heat shield to protect first bank of catalyst from heat damage.
- Performed annual oxidizer training for supervisors and maintenance staff
- Replaced catalytic oxidizer burner in May 2019
- Added vibration testing of catalytic oxidizer to PM program

PCB does not believe this test reflects poor performance of its catalytic oxidation system.

Although we do not believe the test report provides accurate results, PCB is submitting the test report as required by the EGLE approval of test protocol letter dated April 1, 2019. Again, we regret any inconvenience this may have caused. PCB is deeply committed to expediently resolving this issue and continues to be committed to maintaining utmost compliance with all applicable air quality requirements. If you have any questions, please contact me at robert.mason@postholdings.com.

Sincerely,



Robert Mason
Environmental, Health and Safety Manager

Attachments

cc: Monica Brothers, Michigan Department of Environment, Great Lakes, and Energy – Air Quality Division



MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
AIR QUALITY DIVISION

**RENEWABLE OPERATING PERMIT
REPORT CERTIFICATION**

Authorized by 1994 P.A. 451, as amended. Failure to provide this information may result in civil and/or criminal penalties.

Reports submitted pursuant to R 336.1213 (Rule 213), subrules (3)(c) and/or (4)(c), of Michigan's Renewable Operating Permit (ROP) program must be certified by a responsible official. Additional information regarding the reports and documentation listed below must be kept on file for at least 5 years, as specified in Rule 213(3)(b)(ii), and be made available to the Department of Environmental Quality, Air Quality Division upon request.

Source Name Post Foods, LLC County Calhoun

Source Address 275 Cliff Street City Battle Creek

AQD Source ID (SRN) B1548 ROP No. MI-ROP-B1548-2014d ROP Section No. 1

Please check the appropriate box(es):

☐ **Annual Compliance Certification (Pursuant to Rule 213(4)(c))**

Reporting period (provide inclusive dates): From _____ To _____

- ☐ 1. During the entire reporting period, this source was in compliance with **ALL** terms and conditions contained in the ROP, each term and condition of which is identified and included by this reference. The method(s) used to determine compliance is/are the method(s) specified in the ROP.
- ☐ 2. During the entire reporting period this source was in compliance with all terms and conditions contained in the ROP, each term and condition of which is identified and included by this reference, **EXCEPT** for the deviations identified on the enclosed deviation report(s). The method used to determine compliance for each term and condition is the method specified in the ROP, unless otherwise indicated and described on the enclosed deviation report(s).

☐ **Semi-Annual (or More Frequent) Report Certification (Pursuant to Rule 213(3)(c))**

Reporting period (provide inclusive dates): From _____ To _____

- ☐ 1. During the entire reporting period, **ALL** monitoring and associated recordkeeping requirements in the ROP were met and no deviations from these requirements or any other terms or conditions occurred.
- ☐ 2. During the entire reporting period, all monitoring and associated recordkeeping requirements in the ROP were met and no deviations from these requirements or any other terms or conditions occurred, **EXCEPT** for the deviations identified on the enclosed deviation report(s).

☒ **Other Report Certification**

Reporting period (provide inclusive dates): From 06/13/2019 To 06/13/2019

Additional monitoring reports or other applicable documents required by the ROP are attached as described:

Emission testing results for Wet Rotoclone2983 and the Catalytic Oxidizer29113.

I certify that, based on information and belief formed after reasonable inquiry, the statements and information in this report and the supporting enclosures are true, accurate and complete

Ty Hakman
Name of Responsible Official (print or type)

Plant Manager
Title

2699661000x2700
Phone Number

[Signature]
Signature of Responsible Official

6/17/19
Date

ATTACHMENT 1
ANALYTICAL INFORMATION

April 29, 2019

Cathy Sanford
Post Foods, LLC
275 Cliff Street
Battle Creek, MI 49014

RE: Project: Flavor Testing
Pace Project No.: 50222517

Dear Cathy Sanford:

Enclosed are the analytical results for sample(s) received by the laboratory on April 18, 2019. The results relate only to the samples included in this report. Results reported herein conform to the most current, applicable TNI/NELAC standards and the laboratory's Quality Assurance Manual, where applicable, unless otherwise noted in the body of the report.

If you have any questions concerning this report, please feel free to contact me.

Sincerely,



Jennifer Rice
jennifer.rice@pacelabs.com
(616)975-4500
Project Manager

Enclosures

cc: Rob Mason



REPORT OF LABORATORY ANALYSIS

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, LLC.



Pace Analytical Services, LLC
5560 Corporate Exchange Ct. SE
Grand Rapids, MI 49512
(616)975-4500

CERTIFICATIONS

Project: Flavor Testing
Pace Project No.: 50222517

Indiana Certification IDs

7726 Moller Road, Indianapolis, IN 46268
Illinois Certification #: 200074
Indiana Certification #: C-49-06
Kansas/NELAP Certification #: E-10177
Kentucky UST Certification #: 80226
Kentucky WW Certification #: 98019
Michigan Department of Environmental Quality, Laboratory
#9050

Ohio VAP Certification #: CL0065
Oklahoma Certification #: 2018-101
Texas Certification #: T104704355
West Virginia Certification #: 330
Wisconsin Certification #: 999788130
USDA Soil Permit #: P330-16-00257

REPORT OF LABORATORY ANALYSIS

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SAMPLE SUMMARY

Project: Flavor Testing
Pace Project No.: 50222517

Lab ID	Sample ID	Matrix	Date Collected	Date Received
50222517001	29BI _{dg} Oatmeal Flavor (577263)	Water	04/17/19 11:22	04/18/19 08:49
50222517002	29BI _{dg} Oatmeal Flavor (577263)	Water	04/17/19 13:37	04/18/19 08:49

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SAMPLE ANALYTE COUNT

Project: Flavor Testing
Pace Project No.: 50222517

Lab ID	Sample ID	Method	Analysts	Analytes Reported
50222517001	29Bldg Oatmeal Flavor (577263)	EPA 8015 Alcohol-Glycol	CPH	1
50222517002	29Bldg Oatmeal Flavor (577263)	EPA 8015 Alcohol-Glycol	CPH	1

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ANALYTICAL RESULTS

Project: Flavor Testing

Pace Project No.: 50222517

Sample: 29Bldg Oatmeal Flavor (577263)		Lab ID: 50222517001	Collected: 04/17/19 11:22	Received: 04/18/19 08:49	Matrix: Water			
Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
8015M Alcohols in water		Analytical Method: EPA 8015 Alcohol-Glycol						
Ethanol	480000	mg/L	50000	10000		04/23/19 21:25	64-17-5	

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ANALYTICAL RESULTS

Project: Flavor Testing
Pace Project No.: 50222517

Sample: 29Bldg Oatmeal Flavor (577263)		Lab ID: 50222517002	Collected: 04/17/19 13:37	Received: 04/18/19 08:49	Matrix: Water			
Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
8015M Alcohols in water		Analytical Method: EPA 8015 Alcohol-Glycol						
Ethanol	622000	mg/L	50000	10000		04/23/19 21:34	64-17-5	

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QUALITY CONTROL DATA

Project: Flavor Testing
Pace Project No.: 50222517

QC Batch: 496422	Analysis Method: EPA 8015 Alcohol-Glycol
QC Batch Method: EPA 8015 Alcohol-Glycol	Analysis Description: EPA 8015 Modified
Associated Lab Samples: 50222517001, 50222517002	

METHOD BLANK: 2290052 Matrix: Water
Associated Lab Samples: 50222517001, 50222517002

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Ethanol	mg/L	ND	5.0	04/23/19 20:29	

LABORATORY CONTROL SAMPLE: 2290053

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Ethanol	mg/L	50	51.6	103	74-120	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 2290054 2290055

Parameter	Units	5211268001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	Max RPD	Qual
Ethanol	mg/L	ND	50	50	45.9	50.4	92	101	71-122	9 20	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

REPORT OF LABORATORY ANALYSIS

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QUALIFIERS

Project: Flavor Testing
Pace Project No.: 50222517

DEFINITIONS

DF - Dilution Factor, if reported, represents the factor applied to the reported data due to dilution of the sample aliquot.
ND - Not Detected at or above adjusted reporting limit.
TNTC - Too Numerous To Count
J - Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit.
MDL - Adjusted Method Detection Limit.
PQL - Practical Quantitation Limit.
RL - Reporting Limit - The lowest concentration value that meets project requirements for quantitative data with known precision and bias for a specific analyte in a specific matrix.
S - Surrogate
1,2-Diphenylhydrazine decomposes to and cannot be separated from Azobenzene using Method 8270. The result for each analyte is a combined concentration.
Consistent with EPA guidelines, unrounded data are displayed and have been used to calculate % recovery and RPD values.
LCS(D) - Laboratory Control Sample (Duplicate)
MS(D) - Matrix Spike (Duplicate)
DUP - Sample Duplicate
RPD - Relative Percent Difference
NC - Not Calculable.
SG - Silica Gel - Clean-Up
U - Indicates the compound was analyzed for, but not detected.
N-Nitrosodiphenylamine decomposes and cannot be separated from Diphenylamine using Method 8270. The result reported for each analyte is a combined concentration.
Pace Analytical is TNI accredited. Contact your Pace PM for the current list of accredited analytes.
TNI - The NELAC Institute.

REPORT OF LABORATORY ANALYSIS

QUALITY CONTROL DATA CROSS REFERENCE TABLE

Project: Flavor Testing
Pace Project No.: 50222517

Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
50222517001	29Bldg Oatmeal Flavor (577263)	EPA 8015 Alcohol-Glycol	496422		
50222517002	29Bldg Oatmeal Flavor (577263)	EPA 8015 Alcohol-Glycol	496422		

REPORT OF LABORATORY ANALYSIS

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WO#: 50222517



50222517

OF-CUSTODY / Analytical Request Document

Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

Section A

Required Client Information:

Company: Post Foods LLC
Address: 275 Cliff St.
Battle Creek, MI 49014
Email To: cathy.sanford@post
Phone: 269-275-6991
Requested Due Date/TAT:

Report To: Cathy Sanford
Copy To: Rob Mason
robert.mason@postholdings.com
Purchase Order No.: Credit Card
Project Name: 29 Bldg Oatmeal Flavor
Project Number:

Section C

Invoice Information:

Attention:
Company Name:
Address:
Place Quote Reference:
Place Project Manager:
Place Profile:

Page: 1 of 1

2201925

REGULATORY AGENCY

NPDES GROUND WATER DRINKING WATER
UST RCRA OTHER

Site Location

STATE: MI

ITEM #	Section D Required Client Information	SAMPLE ID (A-Z, 0-9 / .-) Sample IDs MUST BE UNIQUE	Matrix Codes MATRIX / CODE	Drinking Water WT Waste Water WW Product P Soil/Solid SL Oil OL Wipe WP Air AR Tissue TS Other OT	MATRIX CODE (see valid codes to left)	SAMPLE TYPE (G=GRAB C=COMP)	COLLECTED				SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Preservatives										Analysis Test #	Y/N	Residual Chlorine (Y/N)	Pace Project No./ Lab I.D.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
							COMPOSITE START		COMPOSITE END/GRAB				Unpreserved	H ₂ SO ₄	HNO ₃	HCl	NaOH	Na ₂ S ₂ O ₃	Methanol	Other																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
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ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	SAMPLE CONDITIONS			
	Rob Mason / POST	4/18/19	8:49 AM	Lyman Reese	4/18/19	8:49				

ORIGINAL

SAMPLER NAME AND SIGNATURE

PRINT Name of SAMPLER: Cathy C. Sanford

SIGNATURE of SAMPLER: Cathy C. Sanford

DATE Signed (MM/DD/YY):

4-17-19

Temp in °C
Received on Ice (Y/N)
Custody Sealed Cooler (Y/N)
Samples Intact (Y/N)

Sample Conditions Upon Receipt

WO#: 50222517

PM: JLR1

Due Date: 05/02/19

CLIENT: GR-Post Food

Date: 4/18/19	Evaluated by: <i>aw</i>	A
Client: Post Foods - Datmeal		
Profile ID:	Project Manager:	
Sample Receiving Non Conformance Form Required: YES NO		Rush Turn Around Time Requested: YES NO Due Date:
Page 1	Of 1	Lab Notified of Rush or Short Holds: YES NO

Lab Sample Receipt Checklist:

Samples Received Via:	FEDEX	UPS	CLIENT	PACE COURIER
Custody Seals Present and Intact:	YES	NO	NA	
USDA Regulated Soils:	YES	NO	NA	
Short Holds Present (< 72 Hours):	YES	NO	NA	
Samples Received in Hold:	YES	NO	NA	
Custody Signatures Present:	YES	NO	NA	
Collector Signature Present:	YES	NO	NA	
Samples Received On Ice:	YES	NO	NA	
Type of Ice: WET BLUE DRY NONE				
Packing Material Used:	YES	NO	NA	
IR Gun #: 202 402 Temp should be 0-6°C	Cooler Temp Upon Receipt: 17.6 °C			
Temp Blank Received:	YES	NO	NA	
Trip Blank Received: Type: HCL MeOH TSP OTHER	YES	NO	NA	
Bottles Intact:	YES	NO	NA	
Correct Bottles:	YES	NO	NA	
Sufficient Volume:	YES	NO	NA	
Sample pH Acceptable: All containers needing preservation are found to be in compliance with EPA recommendation Exceptions are VOA, coliform, TOC, O & G, HEM, DRO	YES	NO	NA	pH Strip Lot Number:
VOA Headspace Acceptable (<6mm):	YES	NO	NA	
Comments:				

Sample Receiving Non-Conformance Form (NCF)

Date: 4/18/19	Evaluated by: aw
Client: Post Foods - Oatmeal	

A	WO#: 50222517	Pace er
PM: JLR1	Due Date: 05/02/19	
CLIENT: GR-Post Food		

1. If Chain-of-Custody (COC) is not received: contact client and if necessary, fill out a COC and indicate that it was filled out by lab personnel. Note issues on this NCF.

2. If COC is incomplete, check applicable issues below and add details where appropriate:

Collection date/time missing or incorrect	Analyses or analytes: missing or clarification needed	Samples listed on COC do not match samples received (missing, additional, etc.)
Sample IDs on COC do not match sample labels	Required trip blanks were not received	Required signatures are missing

Comments/Details/Other Issues not listed above:

3. Sample integrity issues: check applicable issues below and add details where appropriate:

Samples: Past holding time	Samples: Condition needs to be brought to lab personnel's attention (details below)	Preservation: Improper
Samples: Not field filtered	Containers: Broken or compromised	Temperature: not within acceptance criteria (typically 0-6C)
Samples: Insufficient volume received	Containers: Incorrect	Temperature: Samples arrived frozen
Samples: Cooler damaged or compromised	Custody Seals: Missing or compromised on samples, trip blanks or coolers	Vials received with improper headspace
Samples: contain chlorine or sulfides	Packing Material: Insufficient/Improper	Other:

Comments/Details:

Temp = 17-16°C

4. If Samples not preserved properly and Sample Receiving adjusts pH, add details below:

Sample ID:	Date/Time:	Amount/type pres added:
Preserved by:	Initial and Final pH:	Lot # of pres added:
Sample ID:	Date/Time:	Amount/type pres added:
Preserved by:	Initial and Final pH:	Lot # of pres added:
Sample ID:	Date/Time:	Amount/type pres added:
Preserved by:	Initial and Final pH:	Lot # of pres added:

5. Client Contact: If client is contacted for any issue listed above, fill in details below:

Client:	Contacted per:	
PM Initials:	Date/Time:	

Client Comments/Instructions:



11633 Deerfield Rd.
Cincinnati, OH 45242
Telephone: 513.351.6200
FAX: 513.351.4071
www.kbdtechnic.com

**COMPLIANCE TEST REPORT
DETERMINATION OF THE
CAPTURE EFFICIENCY, DESTRUCTION
EFFICIENCY AND REMOVAL EFFICIENCY
OF THE WET ROTOCLONE AND CATALYTIC OXIDIZER
FG2983 COATOXDON
POST CONSUMER BRANDS
BATTLE CREEK, MICHIGAN
APRIL 2019**

Post Consumer Brands Project Coordinator:

Cathy Sanford
275 Cliff Street
Battle Creek MI 49014
(269) 966-1000

**Performed by:
KBD Technic**

Reported by:

Craig Jones
Vice President

Reviewed by:

Mike Schappacher
Senior Project Manager

Job # H723
May 28, 2019

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2.0 INTRODUCTION

Post Consumer Brands operates a food production facility in Battle Creek, Michigan. The source is a flavoring process on one of the production lines in Building 29. The process is designated FG2983CoatOxdOn in the Michigan Department of Environmental Quality ROP NO: MI-ROP-B1548-2014d. KBD Technic was retained by Post Consumer Brands to determine (1) the VOC capture efficiency (CE), (2) the removal efficiency (RE) of the wet rotoclone, (3) the VOC destruction efficiency (DE) of the catalytic oxidizer. The tests were conducted April 17, 2019.

The Michigan Department of Environmental Quality was notified in writing of the test program with the submission of the Test Protocol. Tom Gasloli from the Michigan Department of Environmental Quality witnessed the process operation and testing procedures. Cathy Sanford was the Project Coordinator for Post Consumer Brands. Craig Jones, Mike Schappacher, Warren Wells and Arron Gray of KBD Technic conducted the tests.

3.0 SAMPLING AND ANALYTICAL PROCEDURES

3.1 Capture Efficiency

Refer to Figure 3.1 for a simplified process flow diagram and the location of the test sites for the capture efficiency tests.

The capture efficiency was determined by measuring the captured VOC emissions. The amount of flavoring was monitored and the VOC content of 73.6% was used to determine the VOC applied. An ethanol in air calibration gas was used to determine a propane to ethanol response factor to convert the emission rates from a propane basis to an ethanol basis. Three 60-minute test runs were made.

The CE was calculated using the following equation:

$$CE = \frac{G}{A}$$

Where:

CE = Capture efficiency, %

G = Sum of the captured VOC emissions or VOC emission entering the catalytic oxidizer, lb/hr

A = Applied VOC available for capture, lb/hr

3.2 VOC Removal efficiency and VOC destruction efficiency

The VOC removal efficiency (RE) of the wet rotoclone was determined by continuously monitoring the VOC concentration at the inlet and outlet for three 60-minute periods. The concentration was converted to a mass emission rate based on the stack gas flow rate. These tests were conducted simultaneously with the capture efficiency tests.

The VOC destruction efficiency (DE) of the catalytic oxidizer was determined by continuously monitoring the VOC concentration at the inlet and outlet of the catalytic oxidizer for three 60-minute periods. The concentration at each measurement site was converted to a mass emission rate based on the stack gas flow rate.

The RE was calculated as follows:

$$RE = \frac{ER_{inlet} - ER_{outlet}}{ER_{inlet}}$$

Where:

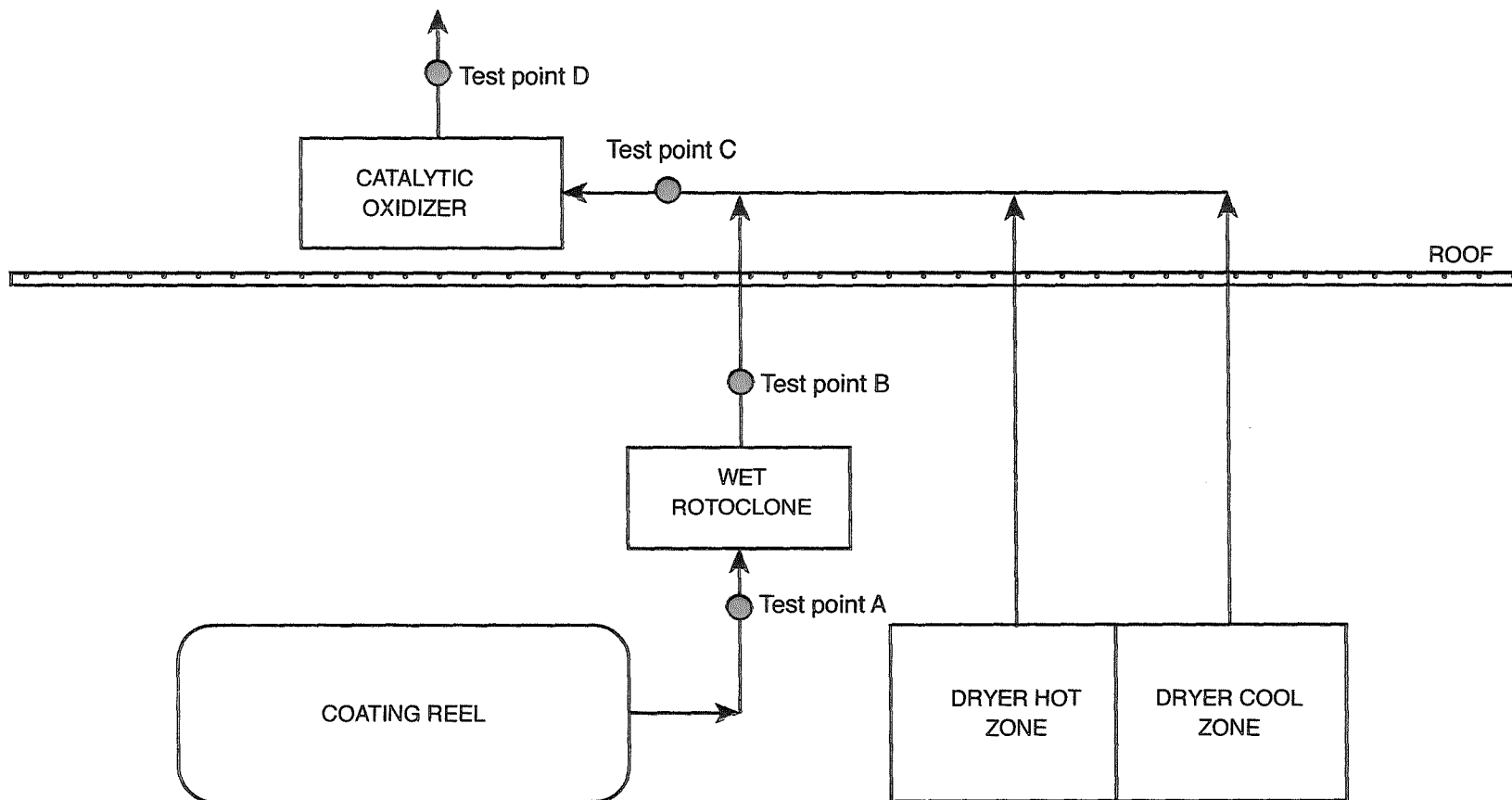
RE = VOC removal efficiency, %

ER_{inlet} = emission rate of VOC determined at the inlet of the wet rotoclone, lb/hr.

ER_{outlet} = emission rate of VOC determined at the outlet of the wet rotoclone, lb/hr.

The DE was calculated as follows:

$$DE = \frac{ER_{inlet} - ER_{outlet}}{ER_{inlet}}$$



● Test sites for VOC and volumetric flow rate

$$\text{Capture efficiency} = \frac{A + (C-B)}{\text{Application rate} \times \% \text{VOC}}$$

Figure 3.1 Process flow diagram