

# **The Permitting and Regulatory Nightmares of Using EPA Method 24 To Determine the VOC Content of Water-Based Coatings and Adhesives**

**Christina J. Schwerdtfeger, Ph.D.**  
**CH2M HILL**  
**3 Hutton Centre Drive**  
**Santa Ana, CA 92707**

**James McHenry**  
**Pactiv Corporation**  
**1900 West Field Court**  
**Lake Forest, IL 60045**

**Keywords:** EPA Method 24, VOC, water-based adhesives, emission reduction credit, honeycomb paper product, kraft paper

## **ABSTRACT**

Many industries throughout the United States use water-based adhesives in their manufacturing processes. These adhesives typically have a very low volatile organic compound (VOC) content of less than 50 grams per liter (g/L). At present, the United States Environmental Protection Agency (EPA) and a California Air Quality Management District (CAQMD) mandate the use of EPA Method 24<sup>1</sup> to determine the VOC content of these materials.

A manufacturer of kraft paper-based products needed to obtain operating permits for several manufacturing lines that use water-based adhesives. The facility uses large quantities of adhesives, typically more than 1,100 gallons per day for various paper-bonding and impregnating applications. Even though EPA Method 24 is the only analytical method recognized by EPA, suppliers of these adhesives utilized other methods to determine and report the VOC content of their products to downstream users.

After embarking on its own analytical testing program to determine the VOC content of its water-based adhesives, the facility found that the results were not reliable or reproducible. The results showed that EPA Method 24 has poor precision and did not match the very low VOC concentrations found on technical data sheets and material safety data sheets (MSDSs) provided by the adhesive suppliers.

Mass emission calculations using EPA Method 24 data grossly overestimated facility VOC emissions and could have resulted in the unnecessary purchase of \$400,000 of emission-reduction credits. CH2M HILL and the kraft paper-based product manufacturer investigated alternative methods to determine the VOC content and spoke to other organizations that were addressing this problem. After the investigation was completed, the CAQMD was successfully convinced that EPA Method 24 results were not appropriate to calculate VOC emissions for coatings or adhesives with high water content.

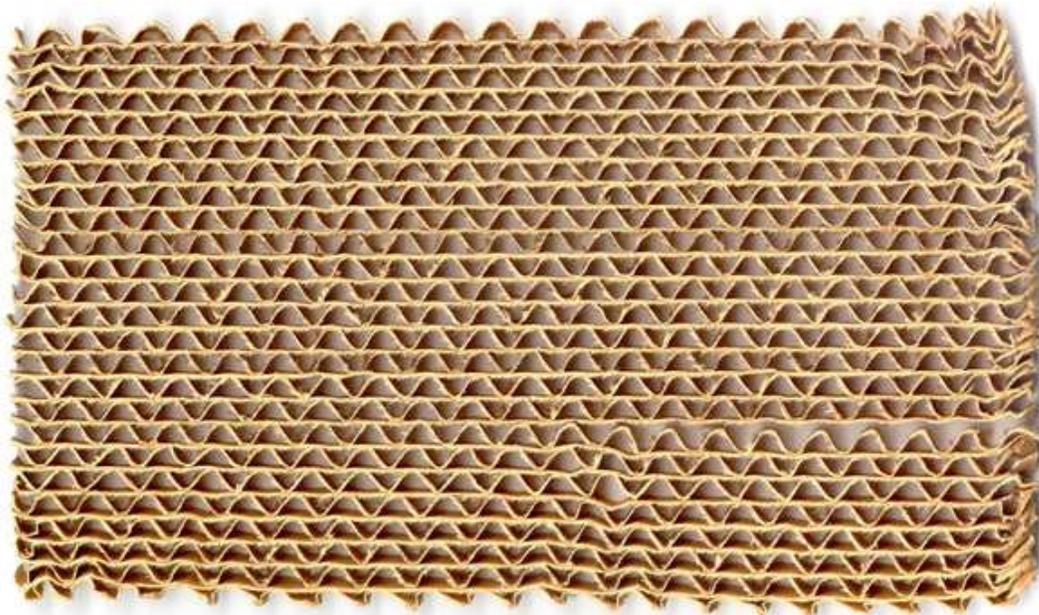
## INTRODUCTION

Honeycomb core and honeycomb panels are kraft paper-based products that are used for consumer product protection, structural applications, and original design packaging for a wide range of products and markets. Honeycomb core is produced by extruding glue in thin lines onto virgin kraft paper (see Photograph 1), cutting the paper into cells, and pressing the cells together to form honeycomb or verticel (see Photograph 2). Honeycomb panels are produced when glue and kraft paper are applied to one or both faces of honeycomb core. See Figure 1 for a process flow diagram.

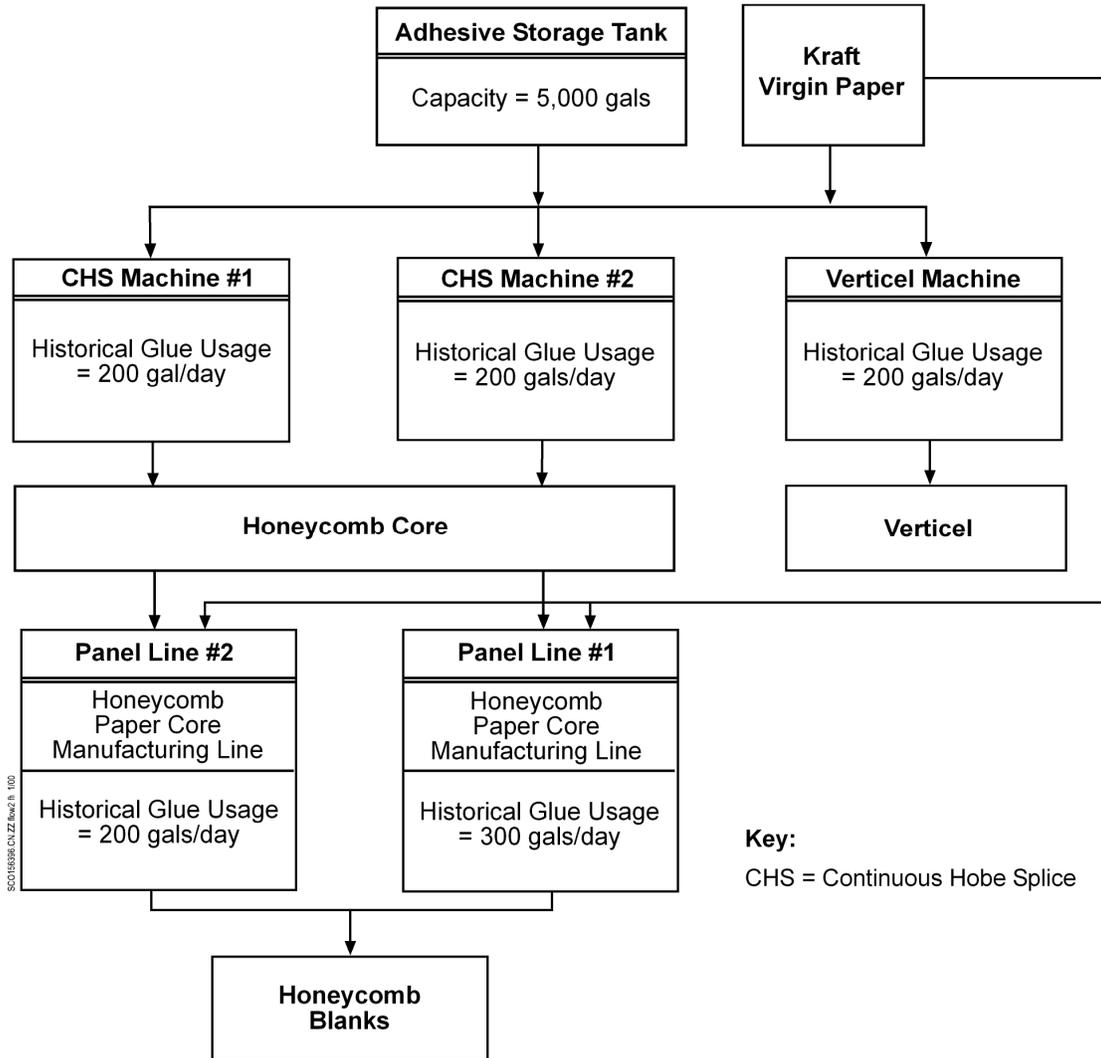
**Photograph 1.** Extrusion of Glue in Thin Lines onto Kraft Paper



**Photograph 2.** Verticel



**Figure 1.** Process Flow Diagram for Honeycomb Products Manufacturing



A manufacturer of kraft paper-based products needed to obtain air quality operating permits for several manufacturing lines located in its California plant. The facility uses large quantities of water-based adhesives, typically more than 1,100 gallons per day on the continuous core machines, vertical machine, and panel lines. The facility had been relying on MSDS information supplied by the former adhesive vendor that indicated VOC content ranged from “negligible” to a maximum of 6 g/L. Based on this information, the facility did not believe it required air permits for much of its equipment. During initial conversations with the CAQMD, the facility was told to use EPA Method 24 to determine the VOC content of the glue to determine rule applicability and to calculate mass emissions.

During the permitting process, the owner of the facility outlined two objectives in order to remain operational at their present location:

- Avoid expensive best available control technologies (BACT) such as an afterburner, which might cost several hundred thousand dollars
- Avoid the purchase of emission reduction credits (ERCs)

## **PROJECT DISCUSSION**

### **Information Provided by Vendors**

Two types of water-based glues needed to be permitted for use in the plant, a primary glue and a secondary glue. Each has its own performance characteristics related to drying time, viscosity, flow rate, and tensile strength. Three vendors (Vendors A, B, and C) provided five glue samples (Glues A, B, C, D and E), the MSDS for each, and other technical information. This written information from the vendors indicated that the VOC content of the five glues ranged from “not applicable” and “negligible” to less than 6 g/L. (See Table 1 for details.)

The vendors used the material composition of each glue and the vapor pressure of individual constituents to calculate the VOC content. The vendors did not provide EPA Method 24 results despite numerous requests. One vendor cautioned us about the reliability of EPA Method 24 data because that vendor’s own analytical laboratory could not produce consistent or accurate results using the method.

After initial performance tests on the glue samples were completed at the plant, it was concluded that Glues A and D met the performance criteria for the plant and would be included in the permit applications. Because of the instructions given by the CAQMD, all glues were tested according to EPA Method 24 while the performance tests were ongoing.

### **EPA Method 24 Results**

Table 1 is a summary of the laboratory results for EPA Method 24 for the five water-based adhesives that underwent performance testing at the kraft paper-product manufacturing facility. Table 1 lists the date of analysis, laboratory identifier, individual lab results, average lab results, and the manufacturer’s VOC content per the MSDS or other correspondence.

**Table 1.** Summary of EPA Method 24 Results for Five Adhesives Considered for Use by a California Manufacturer of Kraft Paper Products

Adhesive	Vendor	EPA Method 24 Results for VOC Content (g/L)				Average Laboratory Result for VOC Content (g/L)	VOC Content per Manufacturer (g/L)
		Lab A 6/22/99	Lab A 6/30/99	Lab B 7/8/99	Lab A 8/19/99		
Glue A	Vendor A	63*	5	12 and 9.9	NS	9	<6
Glue B	Vendor A	4.9	<4	5.6 and 3.3	NS	4.4	NA
Glue C	Vendor A	5.6	54*	8.6 and 11	NS	8.4	Negligible
Glue D	Vendor B	NS	NS	NS	53, 23, and <10	25	2.2
Glue E	Vendor C	8	28	15 and 19	NS	18	0.36

\* Outlier was not included in the calculation of the average and was rejected using the Student's t test with greater than 90 percent certainty.

NS = Not sampled

NA = Not applicable

A couple of points are worth noting from this data.

- There is extreme variation in EPA Method 24 results for the same glue. For example, the laboratories reported values ranging from “nondetect” to 53 g/L for Glue D. The difference between the highest and lowest values for Glue D is 530 percent. For Glue A, the difference is 1,260 percent.
- In most cases, EPA Method 24 results are significantly higher than the VOC information provided by the manufacturer in the MSDS or other technical information.
- The analytical results obtained are widely variable and, therefore, do not appear to be appropriate for calculating mass emissions.

EPA Method 24 results were subsequently used to determine rule applicability, calculate mass emissions, determine BACT, and identify whether ERCs would be required. All of these proceeded without any problems except for the ERC determination as described below.

## Emission Reduction Credits

The owner of the facility was concerned that a substantial financial investment to purchase ERCs would be needed if daily emissions exceeded 52 pounds of VOCs per day. This is the new source review (NSR) balance for the facility. Accordingly, the

quantity of ERCs that would be needed and the associated financial burden to the owner using the various VOC results obtained in this study were calculated. Table 2 summarizes the results of these calculations and shows that the financial burden varied from \$0 to \$391,000. The VOC content of Glues A and D ranged from less than 6 g/L to 50 g/L, depending on the source of data (MSDS, technical information from vendor, EPA Method 24 results, or reporting limit from the CAQMD laboratory).<sup>2,3</sup>

**Table 2.** Cost of ERCs for the Kraft Paper Product Manufacturing Facility Located in California Using Different VOC Values to Calculate Mass Emissions

<b>Material Name</b>	<b>VOC Content</b>	<b>Source of VOC Content</b>	<b>Emissions Above NSR Balance (lbs/day)</b>	<b>Cost to Purchase ERCs*</b>
Glue D	2.2 g/L	MSDS	0	\$0
Glue A	<6 g/L	MSDS	22	\$17,600
Glue A	9 g/L	EPA Method 24	71	\$57,000
Glue D	25 g/L	EPA Method 24	239	\$192,000
Glues A and D	50 g/L	CAQMD Reporting Limit	488	\$391,000

\*Assumes that ERCs for VOCs cost approximately \$800 per pound per day and that the manufacturing facility will use 1,100 gallons of glue each day.

To resolve these discrepancies and avoid a large financial burden for the owner, several organizations were contacted to obtain relevant data, facts and guidance.

### **Reporting Limit from Laboratory**

First, the laboratory director at CAQMD was asked about the reliability and accuracy of EPA Method 24 when used on water-based adhesives. She said that the laboratory does not report values less than 50 g/L because of cumulative errors that make the data inherently unreliable.<sup>4,5</sup> The permit writer at CAQMD was not aware of the reporting limit used by laboratory counterparts until this information was forwarded to them in August 1999. Unfortunately, knowledge of this important and relevant fact did not dismiss the requirement to use EPA Method 24 for calculating mass emissions at that time.

## **EPA's Position**

The EPA web site was searched to identify other supporting facts and technical guidance to bolster our position with CAQMD. It was discovered that the Emission Measurement Branch of EPA had issued a Stack Note in April 1994 stating:

*The current version of Method 24, located in Part 60 Appendix A of the Code of Federal Regulations, does not adequately address the following type of coatings and inks: ...2) water-based (containing less than 5 percent VOCs by weight) including those which produce water as a reaction by-product...<sup>6</sup>*

EPA further stated in the Stack Note that a draft method for water-based coatings was under development using activated charcoal tubes and that round-robin testing was underway.

EPA's Emission Measurement Center (EMC) was contacted to get an update on these studies. EPA stated:

*We are aware that there can be variability in the result, especially when it is a very low VOC content and high water content. The charcoal method mentioned in the message did not work out as hoped and is no longer being considered. We are however finishing up on a round-robin on an automated thermal desorption method and hope that this will provide us with a better way for determining the VOC content of water-based coatings. We should know if we will go forward with proposing this method by the end of the year.<sup>7</sup>*

## **CMA Efforts**

Another organization contacted was the Chemical Manufacturer's Association (CMA), who had convened a VOC Task Group in October 1994 to improve the measurement of VOCs in specialty chemicals. The VOC Task Group was disbanded in 1998 because they were concerned about spending additional funds to identify and justify alternative methods without a guarantee that EPA would accept their data and recommendations. Before they disbanded, the Task Group evaluated data from the National Council for Air and Steam Improvement (NCASI) and drew the following conclusions:

*The NCASI data demonstrates that EPA Method 24 does grossly overestimate the VOC observed in the mill studies. The NCASI data showed that all chemicals had a volatilized mass fraction of 25% or less.<sup>8</sup>*

## **Final Discussion with CAQMD**

The information and data contained in this paper were summarized and provided to the permit writer from CAQMD in September 1999. Emphasis was made that a huge financial burden was being imposed on the kraft paper-product manufacturer and not on their competitors. After a week of deliberations with management, they agreed that, in this case, the VOC content from the MSDS and other technical information from vendors were more reliable than EPA Method 24 results and could be used to calculate mass emissions.

## **CONCLUSIONS**

Based on the results of these tests, it was concluded that EPA Method 24 is not appropriate to analyze the VOC content of water-based adhesives and coatings. Using EPA Method 24 results to calculate mass emissions would have resulted in a large financial burden to the owner of the kraft paper-product manufacturing plant. With persistence and significant investigation into EPA and trade group activities, our client realized several hundred thousand dollars in ERCs.

## **ACKNOWLEDGEMENTS**

Thank you to Mr. Carlos Ruiz, who was invaluable in explaining the Hexacomb manufacturing process and in providing his insights on the realities of business operations in Southern California. Thank you also to Mr. Bill Forcade, who provided valuable feedback and suggestions on how to deal with agency personnel.

## **REFERENCES**

1. *Determination of Volatile Matter Content, Water Content, Density, Volume Solids, and Weight Solids of Surface Coatings.* 40 CFR 60, Appendix A, Method 24.
2. Grubb, Carol Ann, Air Products and Chemicals, Inc. Letter to GTM Industries "Volatile Organic Compounds (VOCs) Poly Vinyl Alcohol." 31 August 1999.
3. Berrier, Phillip. Reichold, Inc. Correspondence on 18 May 1999 and E-mails through 24 June 1999.
4. Niertit, Joan. South Coast Air Quality Management District. E-Mail Correspondence. August 1999.
5. *Determination of Volatile Organic Compounds (VOC) in Various Materials.* SCAQMD Method 304-91.

6. EPA Stack Notes. Volume 2, April 1992:  
<http://www.epa.gov/ttnemc01.stknotes/stknv202.txt> (accessed September 3, 1999).
7. Sorrel, Candace, Environmental Protection Agency, Emission Measurement Center. Telephone Conversation. August 1999.
8. Chemical Manufacturer's Association, VOC Task Group. *Summary of the VOC Modeling Project*. February 1998.