Reference 3 -- See Sections 1 through 4 of the Final Report for Section 9.5.3 dated September, 1995.

Emission Factor Documentation for AP-42
Section 9.5.3

Meat Rendering Plants

Final Report

For U. S. Environmental Protection Agency
Office of Air Quality Planning and Standards
Emission Factor and Inventory Group

EPA Contract No. 68-D2-0159
Work Assignment No. II-03

MRI Project No. 4602-03

September 1995

Emission Factor Documentation for AP-42 Section 9.5.3

Meat Rendering Plants

Final Report

For U. S. Environmental Protection Agency
Office of Air Quality Planning and Standards
Emission Factor and Inventory Group
Research Triangle Park, NC 27711

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NOTICE

The information in this document has been funded wholly or in part by the United States Environmental Protection Agency under Contract No. 68-D2-0159 to Midwest Research Institute. It has been subjected to the Agency's peer and administrative review, and it has been approved for publication as an EPA document. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

PREFACE

This report was prepared by Midwest Research Institute (MRI) for the Office of Air Quality Planning and Standards (OAQPS), U. S. Environmental Protection Agency (EPA), under EPA Contract No. 68-D2-0159. The EPA work assignment manager for this project is Mr. Dallas Safriet.

Approved for:

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September 1995

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1. INTRODUCTION

The document *Compilation of Air Pollutant Emissions Factors* (AP-42) has been published by the U. S. Environmental Protection Agency (EPA) since 1972. Supplements to AP-42 have been issued to add new emission source categories and to update existing emission factors. The EPA also routinely updates AP-42 in response to the needs of federal, state, and local air pollution control programs and industry.

An emission factor is a representative value that attempts to relate the quantity of a pollutant released to the atmosphere with an activity associated with the release of that pollutant. Emission factors usually are expressed as the weight of pollutant divided by the unit weight, volume, distance, or duration of the activity that emits the pollutant. The emission factors presented in AP-42 may be appropriate to use in a number of situations, such as making source-specific emission estimates for areawide inventories for dispersion modeling, developing control strategies, screening sources for compliance purposes, establishing operating permit fees, and making permit applicability determinations. The purpose of this background report is to provide information to support preparation of AP-42 Section 9.5.3, Meat Rendering Plants.

This report contains five sections. Following this introduction, Section 2 gives a description of the meat rendering industry including a brief characterization of the industry, an overview of the process, and the identification of emissions and emission control technology. Section 3 describes the literature search, screening of emission source data, and the EPA quality ranking system for emission data and emission factors. Section 4 describes the results of the literature search. Section 5 presents the proposed AP-42 Section 9.5.3, Meat Rendering Plants.

2. INDUSTRY DESCRIPTION[1]

This section provides an overview of the U. S. rendering industry for the preparation of products for human consumption (edible rendering) and products not suitable for human consumption (inedible rendering). This section is divided into four subsections: industry characterization (2.1), process description (2.2), emissions (2.3), and emission control technology (2.4). The edible rendering industry is included in Standard Industrial Classification (SIC) Code 2011 and inedible rendering in SIC Code 2077.

2.1 INDUSTRY CHARACTERIZATION[1]

Rendering plants process animal by-product materials for the production of tallow, grease, and high-protein meat and bone meal. Plants that operate in conjunction with animal slaughterhouses or poultry processing plants are called integrated rendering plants. Plants that collect their raw materials from a variety of offsite sources are called independent rendering plants. Independent plants obtain animal by-product materials, including grease, blood, feathers, offal, and entire animal carcasses, from the following sources: butcher shops, supermarkets, restaurants, fast-food chains, poultry processors, slaughterhouses, farms, ranches, feedlots, and animal shelters.

The two types of animal rendering processes are edible and inedible rendering. Edible rendering plants process fatty animal tissue into edible fats and proteins. The plants are normally operated in conjunction with meat packing plants under U. S. Department of Agriculture, Food Safety and Inspection Services (USDA/FSIS) inspection and processing standards. Inedible rendering plants are operated by independent renderers or are part of integrated rendering operations. These plants produce inedible tallow and grease, which are used in livestock and poultry feed, soap, and production of fatty-acids. The Source Classification Code (SCC) for animal/poultry rendering is 3-02-038-01 (General).

Since the early 1980's, the number of independent rendering plants has significantly declined because less raw material is available due to changes in the meat packing industry. Also, a downward trend in tallow and grease prices has contributed to the declining number of plants. In 1992, an estimated 150 independent rendering plants and 100 integrated plants were operating in the United States.

2.2 PROCESS DESCRIPTION[1]

2.2.1 Edible Rendering

A typical edible rendering process is shown in Figure 2-1. Fat trimmings, usually consisting of 14 to 16 percent fat, 60 to 64 percent moisture, and 22 to 24 percent protein, are ground and then belt conveyed to a melt tank. The melt tank heats the materials to about 43°C (110°F), and the melted fatty tissue is pumped to a disintegrator, which ruptures the fat cells. The proteinaceous solids are separated from the melted fat and water by a centrifuge. The melted fat and water are then heated with steam to about 93°C (200°F) by a shell and tube heat exchanger. A second-stage centrifuge then separates the edible fat from the water, which also contains any remaining protein fines. The water is discharged as sludge, and the "polished" fat is pumped to storage. Throughout the process, direct heat contact with the edible fat is minimal and no cooking vapors are directly emitted. Because no vapors are emitted, no emission points are designated in Figure 2-1.

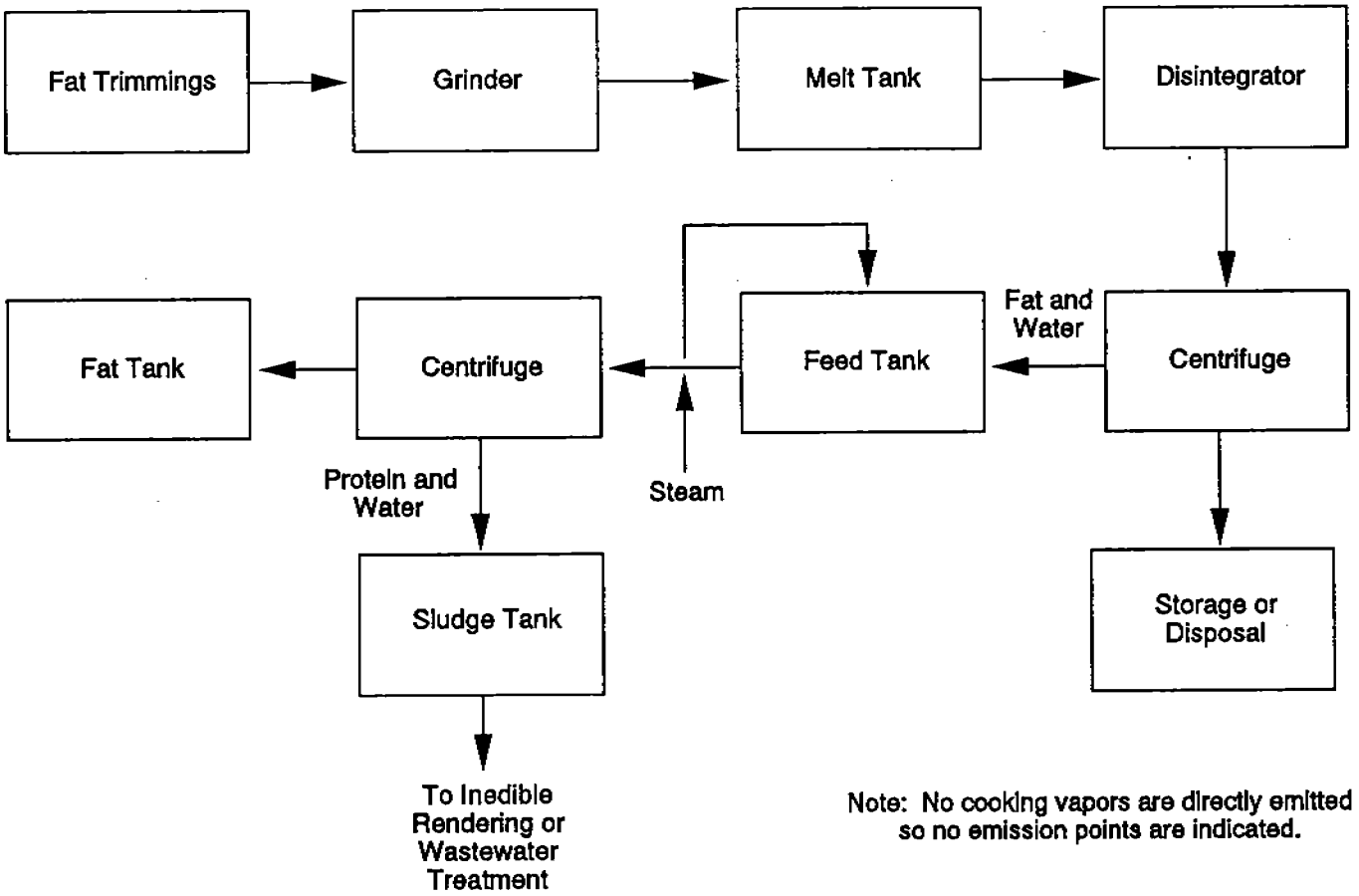

Figure 2-1. Edible rendering process.

2.2.2 Inedible Rendering

Integrated rendering plants normally process only one type of raw material, whereas independent rendering plants often handle several raw materials that require either multiple rendering systems or significant modifications in the operating conditions for a single system. Table 2-1 shows the fat, protein, and moisture contents for several raw materials processed by inedible rendering plants.

There are two processes for inedible rendering: the wet process and the dry process. Wet rendering is a process that separates fat from raw material by boiling in water. The process involves addition of water to the raw material and the use of live steam to cook the raw material and accomplish separation of the fat. Dry rendering is a batch or continuous process that dehydrates raw material in order to release fat. Following dehydration in batch or continuous cookers, the melted fat and protein solids are separated. At present, only dry rendering is used in the United States. The wet rendering process is no longer used because of the high cost of energy and of an adverse effect on the fat quality. The following paragraphs describe each stage in the dry rendering process.

2.2.2.1 Batch Rendering Process. Figure 2-2 shows the basic inedible rendering process using multiple batch cookers. In the batch process, the raw material from the receiving bin is screw conveyed to a crusher where it is reduced to 2.5 to 5 centimeters (cm) (1 to 2 inches [in.]) in size to improve cooking efficiency. Cooking normally requires 1.5 to 2.5 hr, but adjustments in the cooking time and temperature may be required to process the various materials. A typical batch cooker is a horizontal, cylindrical vessel equipped with a steam jacket and an agitator. To initiate the cooking process, the cooker is charged with raw material and the material is heated to a final temperature ranging from 121° to 135°C (250° to 275°F). Following the cooking cycle, the contents are discharged to the percolator drain pan. Vapor emissions from the cooker pass through a condenser, which condenses the water vapor and emits the noncondensibles as VOC emissions.

The percolator drain pan contains a screen that separates the liquid fat from the protein solids. From the percolator drain pan, the protein solids, which still contain about 25 percent fat, are conveyed to the screw press. The screw press completes the separation of fat from solids, and yields protein solids that have a residual fat content of about 10 percent. These solids, called cracklings, are then ground and screened to produce protein meal. The fat from both the screw press and the percolator drain pan is pumped to the crude animal fat tank, centrifuged or filtered to remove any remaining protein solids, and stored in the animal fat storage tank.

2.2.2.2 Continuous Rendering Process. Since the 1960's, continuous rendering systems have been installed to replace batch systems at some plants. A typical continuous rendering process is shown in Figure 2-3. The system is similar to a batch system except that a single, continuous cooker is used rather than several parallel batch cookers. A typical continuous cooker is a horizontal, steam-jacketed cylindrical vessel equipped with a mechanism that continuously moves the material horizontally through the cooker. Continuous cookers cook the material faster than batch cookers, and typically produce a higher quality fat product. From the cooker, the material is discharged to the drainer, which serves the same function as the percolator drain pan in the batch process. The remaining operations are generally the same as the batch process operations.

In the 1980's, newer continuous rendering systems were developed to precook the raw material and to remove moisture from the liquid fat prior to the cooker/drier stage. These systems utilize an evaporator operated under vacuum and heated by the vapors from the cooker/drier. One

TABLE 2-1. COMPOSITION OF RAW MATERIALS FOR INEDIBLE RENDERING[a]

Source	Tallow/grease, Wt %	Protein solids Wt %	Moisture, Wt %
Packing house offal[b] and bone			
Steers	30-35	15-20	45-55
Cows	10-20	20-30	50-70
Calves	10-15	15-20	65-75
Sheep	25-30	20-25	45-55
Hogs	25-30	10-15	55-65
Poultry offal	10	25	65
Poultry feathers	None	33	67
Dead stock (whole animals)			
Calves	10	22	68
Sheep	22	25	53
Hogs	30	28	42
Butcher shop fat and bone	31	32	37
Blood	None	16-18	82-84
Restaurant grease	65	10	25

[a]Reference 1.
[b]Waste parts; especially the entrails and similar parts from a butchered animal.

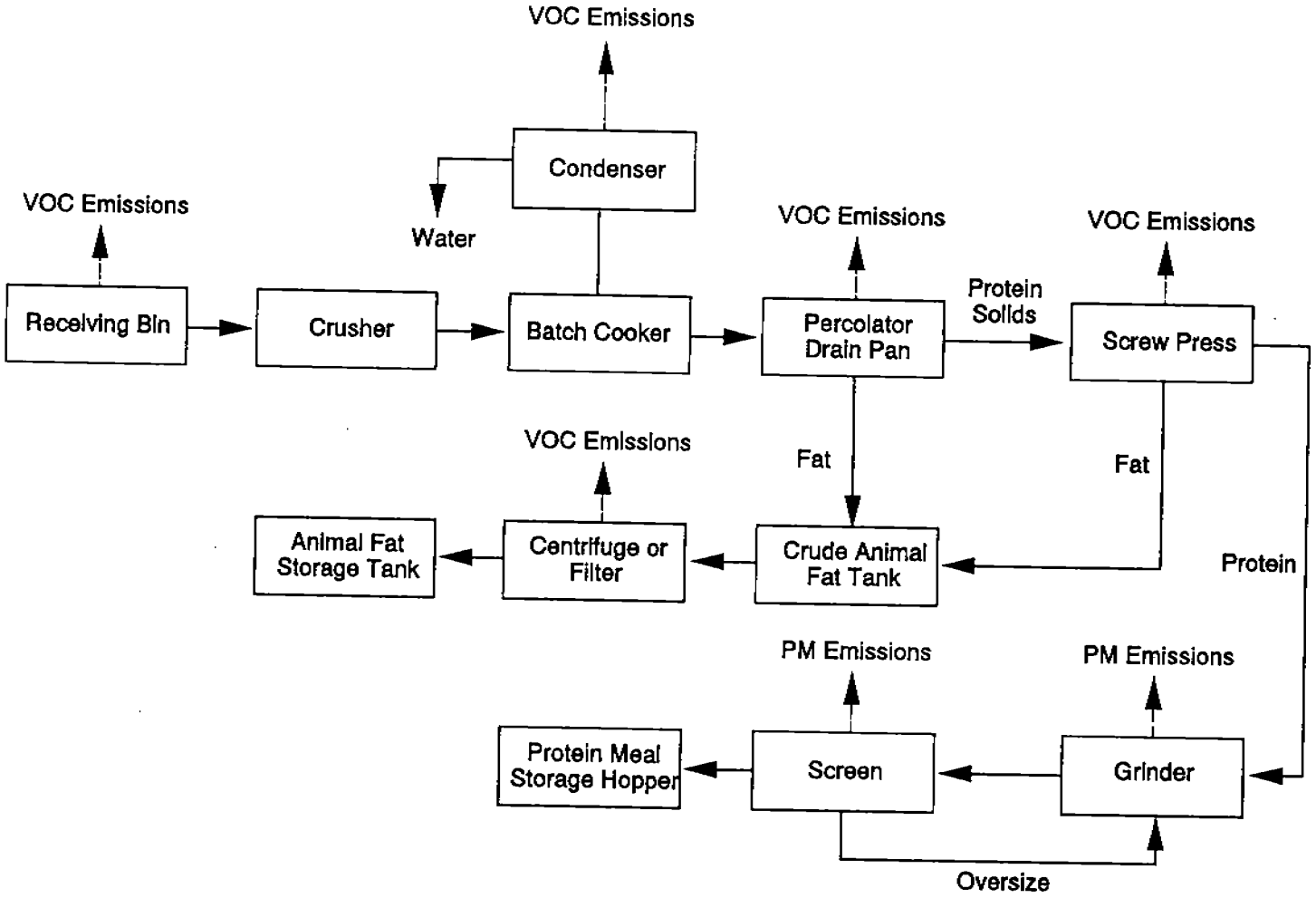

Figure 2-2. Batch cooker rendering process.

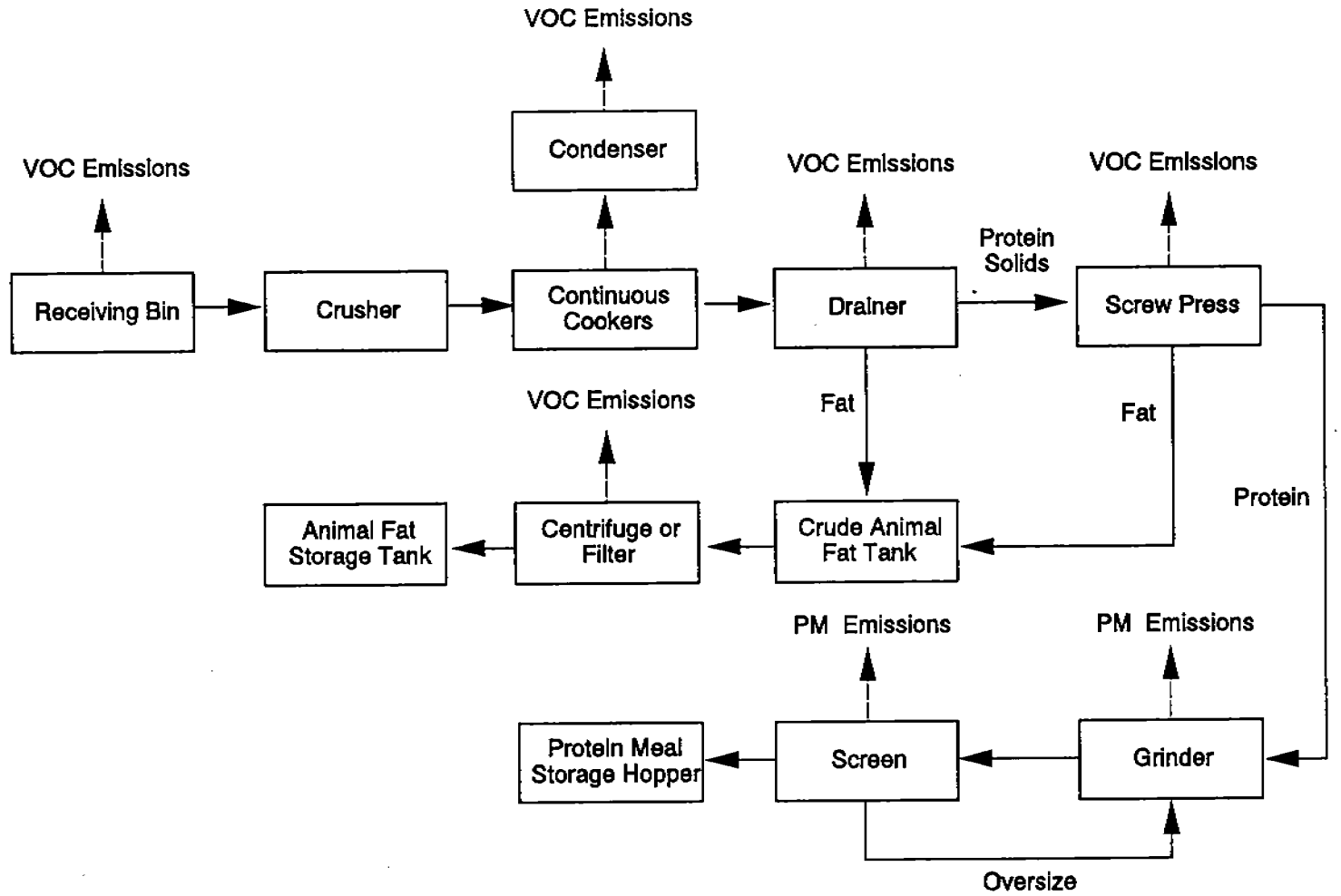

Figure 2-3. Continuous rendering process.

system, termed waste-heat dewatering (WHD), consists of treating the raw material in a preheater followed by a twin-screw press. The solids from the press are directed to the cooker/drier. The liquid fat is sent to an evaporator operated under a vacuum and heated by the hot vapors from the cooker/drier to a temperature of 70° to 90°C (160° to 200°F). In the evaporator, the moisture evaporates from the liquid fat and passes to a water-cooled condenser. The dewatered fat is recombined with the solids from the screw press prior to entry into the cooker/drier. These pretreatment systems may reduce fuel costs by 30 to 40 percent and increase production throughput by up to 75 percent.

2.2.2.3 Blood Processing and Drying. Blood processing and drying is an auxiliary process in meat rendering operations. At the present time, less than 10 percent of the independent rendering plants in the U.S. process whole animal blood. Whole blood from animal slaughterhouses, containing 16 to 18 percent total protein solids, is processed and dried to recover protein as blood meal. The blood meal is a valuable ingredient in animal feed because it has a high lysine content. Continuous cookers have replaced batch cookers that were originally used in the industry because of the improved energy efficiency and product quality provided by continuous cookers. In the continuous process, whole blood is introduced into a steam-injected, inclined tubular vessel in which the blood solids coagulate. The coagulated blood solids and liquid (serum water) are then separated in a centrifuge, and the blood solids dried in either a continuous gas-fired, direct-contact ring dryer or a steam tube, rotary dryer.

2.2.2.4 Poultry Feathers and Hog Hair Processing. The raw material is introduced into a batch cooker, and is processed for 30 to 45 minutes (min) at temperatures ranging from 138° to 149°C (280° to 300°F) and pressures ranging from (40 to 50 psig). This process converts keratin, the principal component of feathers and hog hair, into amino acids. The moist meal product, containing the amino acids, is passed either through a hot air, ring-type dryer or over steam-heated tubes to remove the moisture from the meal. If the hot air dryer is used, the dried product is separated from the exhaust by cyclone collectors. In the steam-heated tube system, fresh air is passed countercurrent to the flow of the meal to remove the moisture. The dried meal is transferred to storage. The exhaust gases are passed through controls prior to discharge to the atmosphere.

2.2.2.5 Grease Processing. Grease from restaurants is recycled as another raw feed material processed by rendering plants. The grease is bulk loaded into vehicles, transported to the rendering plant, and discharged directly to the grease processing system. During processing, the melted grease is first screened to remove coarse solids, and then heated to about 93°C (200°F) in vertical processing tanks. The material is then stored in the processing tank for 36 to 48 hr to allow for gravity separation of the grease, water, and fine solids. Separation normally results in four phases: (1) solids, (2) water, (3) emulsion layer, and (4) grease product. The solids settle to the bottom and are separated from the water layer above. The emulsion is then processed through a centrifuge to remove solids and another centrifuge to remove water and any remaining fines. The grease product is skimmed off the top.

2.3 EMISSIONS[1,2]

Volatile organic compounds (VOCs) are the primary air pollutants emitted from rendering operations. The major constituents that have been qualitatively identified as potential emissions include particulate, ammonia, hydrogen sulfide, organic sulfides, disulfides, C-4 to C-7 aldehydes, trimethylamine, C-4 amines, quinoline, dimethyl pyrazine, other pyrazines, and C-3 to C-6 organic acids. In addition, lesser amounts of C-4 to C-7 alcohols, ketones, aliphatic hydrocarbons, and

aromatic compounds are potentially emitted. No quantitative emission data were presented. Historically, the VOCs are considered to be an odor nuisance in residential areas in close proximity to rendering plants, and emission controls are directed toward odor elimination. The odor detection thresholds for many of these compounds are low; some as low as 1 part per billion (ppb). Of the specific constituents listed, only quinoline is classified as a hazardous air pollutant (HAP). In addition to emissions from rendering operations, VOCs may be emitted from the boilers used to generate steam for the operation.

Emissions from the edible rendering process are not considered to be significant because no cooking vapors are emitted and direct heat contact with the edible fat is minimal. Therefore, these emissions are not discussed further.

For inedible rendering operations, the primary sources of VOC emissions are the cookers and the screw press. Other sources of VOC emissions include blood and feather processing operations, dryers, centrifuges, tallow processing tanks, and percolator pans that are not enclosed. Raw material may also be a source of VOC emissions, but if the material is processed in a timely manner, these emissions are minimal.

In addition to VOC emissions, particulate matter (PM) is emitted from grinding and screening of the solids (cracklings) from the screw press and other rendering operations such as dryers processing blood and feathers.

2.4 EMISSION CONTROL TECHNOLOGY[1,2]

Emission control at rendering plants is primarily based on the elimination of odor. These controls are divided into two categories: (1) those controlling high intensity odor emissions from the rendering process, and (2) those controlling plant ventilation air emissions. The control technologies that are typically used for high intensity odors from rendering plant process emissions are waste heat boilers (incinerators) and multistage wet scrubbers.

Boiler incinerators are a common control technology because boilers can be used not only as control devices but also to generate steam for cooking and drying operations. In waste heat boilers, the waste stream can be introduced into the boiler as primary or secondary combustion air. Primary combustion air is mixed with fuel before ignition to allow for complete combustion, and secondary combustion air is mixed with the burner flame to complete combustion. Gaseous waste streams that contain noncondensibles are typically "cleaned" in a combination scrubber and entrainment separator before use as combustion air.

Multistage wet scrubbers using various scrubbing agents are the primary alternative to incinerators. They can be equally as effective as incinerators for high intensity odor control and are used to about the same extent as incinerators. Sodium hypochlorite is considered to be the most effective scrubbing agent for odor removal, although other oxidants can be used. Recently, chlorine dioxide has been used as an effective scrubbing agent. Venturi scrubbers are often used to remove PM from waste streams before treatment by the multistage wet scrubbers because large particles tend to deplete the oxidizing agent used in the multistage scrubbing system. A typical multistage wet scrubber system consists of a venturi scrubber followed by one or two packed bed scrubbers.

Plants that are located near residential or commercial areas may treat process and fugitive emissions by ducting the plant ventilation air through a wet scrubbing system to minimize odorous

emissions. Wet scrubbing of plant ventilation air is an effective means of controlling odor emissions. In these systems, vents from the buildings that house the various processes are ducted to a single-stage scrubber, usually a packed bed scrubber using sodium hypochlorite as the scrubbing agent. When used in conjunction with multistage wet scrubbers controlling process emissions, these systems may provide up to 99 percent control of odor emissions.

In addition to the conventional scrubber control technology, activated carbon adsorption and catalytic oxidation potentially could be used to control odor; however, no rendering plants currently use these technologies. Recently, some plants have installed biofilters to control emissions.

References for Section 2

1. W.H. Prokop, "Rendering Plants," in Chapter 13, Food and Agriculture Industry, Air Pollution Engineering Manual, Van Nostrand Reinhold Press, 1992.

2. H.J. Rafson, "Odor Emission Control for the Food Industry." Food Technology, June 1977.

3. GENERAL DATA REVIEW AND ANALYSIS PROCEDURES

3.1 LITERATURE SEARCH AND SCREENING

Review of emissions data began with a literature and source test search. First, EPA literature and data were reviewed including review of the AP-42 background files located in the Emission Factor and Inventory Group (EFIG) and data base searches on the Crosswalk/Air Toxic Emission Factor Data Base Management System (XATEF), the VOC/PM Speciation Data Base Management System (SPECIATE), and the Air Chief CD-ROM. New references were identified primarily through reviews of literature describing changes in meat rendering technology.

During the review of each document, the following criteria were used to determine the acceptability of reference documents for emission factor development:

1. The report must be a primary reference:

    a. Source testing must be from a referenced study that does not reiterate information from previous studies.

    b. The document must constitute the original source of test data.

2. The referenced study must contain test results based on more than one test run.

3. The report must contain sufficient data to evaluate the testing procedures and source operating conditions.

3.2 DATA QUALITY RATING SYSTEM[1]

Based on OAQPS guidelines, the following data are always excluded from consideration in developing AP-42 emission factors:

1. Test series averages reported in units that cannot be converted to the selected reporting units;

2. Test series representing incompatible test methods; and

3. Test series in which the production and control processes are not clearly identified and described.

If there is no reason to exclude a particular data set, data are assigned a quality rating based on an A to D scale specified by OAQPS as follows:

A—This rating requires that multiple tests be performed on the same source using sound methodology and reported in enough detail for adequate validation. Tests do not necessarily have to conform to the methodology specified by EPA reference test methods, although such methods are used as guides.

B—This rating is given to tests performed by a generally sound methodology but lacking enough detail for adequate validation.

C—This rating is given to tests that are based on an untested or new methodology or that lack a significant amount of background data.

D—This rating is given to tests that are based on a generally unacceptable method but may provide an order-of-magnitude value for the source.

The following are the OAQPS criteria used to evaluate source test reports for sound methodology and adequate detail:

1. Source operation. The manner in which the source was operated should be well documented in the report, and the source should be operating within typical parameters during the test.

2. Sampling procedures. The sampling procedures should conform to a generally accepted methodology. If actual procedures deviate from accepted methods, the deviations must be well documented. When this occurs, an evaluation should be made of how such alternative procedures could influence the test results.

3. Sampling and process data. Adequate sampling and process data should be documented in the report. Many variations can occur without warning during testing and sometimes without being noticed. Such variations can induce wide deviations in sampling results. If a large spread between test results cannot be explained by information contained in the test report, the data are suspect and are given a lower rating.

4. Analysis and calculations. The test reports should contain original raw data sheets. The nomenclature and equations used are compared to those specified by EPA (if any) to establish equivalency. The depth of review of the calculations is dictated by the reviewer's confidence in the ability and conscientiousness of the tester, which in turn is based on factors such as consistency of results and completeness of other areas of the test report.

3.3 EMISSION FACTOR QUALITY RATING SYSTEM[1]

The EPA guidelines specify that the quality of the emission factors developed from analysis of the test data be rated utilizing the following general criteria:

A—Excellent: The emission factor was developed only from A-rated test data taken from many randomly chosen facilities in the industry population. The source category* was specific enough to minimize variability within the source category population.

B—Above average: The emission factor was developed only from A-rated test data from a reasonable number of facilities. Although no specific bias was evident, it was not clear if the facilities tested represented a random sample of the industries. As in the A-rating, the source category was specific enough to minimize variability within the source category population.

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* Source category: A category in the emission factor table for which an emission factor has been calculated.

C—Average: The emission factor was developed only from A- and B-rated test data from a reasonable number of facilities. Although no specific bias was evident, it was not clear if the facilities tested represented a random sample of the industry. As in the A-rating, the source category was specific enough to minimize variability within the source category population.

D—Below average: The emission factor was developed only from A- and B-rated test data from a small number of facilities, and there was reason to suspect that these facilities did not represent a random sample of the industry. There also may be evidence of variability within the source category population. Limitations on the use of the emission factor are footnoted in the emission factor table.

E—Poor: The emission factor was developed from C- and D-rated test data, and there was reason to suspect that the facilities tested did not represent a random sample of the industry. There also may be evidence of variability within the source category population. Limitations on the use of these factors are footnoted.

The use of the above criteria is somewhat subjective depending to a large extent on the individual reviewer. Details of how each candidate emission factor was rated are provided in Section 4.

References for Section 3

1. *Technical Procedures for Developing AP-42 Emission Factors and Preparing AP-42 Sections*, EPA-454/B-93-050, U. S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC, October 1993.

4. AP-42 SECTION DEVELOPMENT

This section describes the test data and methodology used to develop pollutant emission factors for the meat rendering industry. Section 9.5.3, Meat Rendering Plants will be new to Chapter 9 of AP-42.

4.1 REVIEW OF SPECIFIC DATA SETS[1-2]

During the literature search, only three test reports were found and one report was unsuitable for the calculation of emission factors because of the lack of process data. The other reports characterized emissions from a natural gas-fired blood dryer. A summary of each of the three references is provided below but only References 2 and 3 were used to estimate emission factors.

4.1.1 Reference 1

An emissions test was conducted at the Darlings Delaware rendering plant in Fresno, California to determine if a specific group of compounds were present at selected locations in the emissions control system. The specific compound and groups of compounds of interest were formaldehyde, trace organics, mercaptans, amines, organic acids, and C_2-C_{10} hydrocarbons. The four sampling locations were the outlets of wet scrubbers #1 and #2, and the inlet and outlet of a waste heat incinerator. No process description or process data were provided. Only a single test run was performed at each sampling location. The results of this emission test are unsuitable for estimation of emission factors because there are no process data to form the basis for an emission factor. Portions of this test report are provided in Appendix A.

4.1.2 Reference 2

This test report summarizes the results of emission tests for the blood dryer at the Milwaukee Tallow Company. The tests were conducted in September 1989 to provide compliance data for PM/PM-10, hydrogen sulfide, and ammonia. Triplicate tests were conducted in the vent stack for each pollutant using EPA Method 5 for particulate emissions (both filterable PM-10 and condensible PM were reported), EPA Method 11 for hydrogen sulfide, and NIOSH P&CAM Method 125 for ammonia. A six stage in-stack Cascade Impactor was used to collect particle size samples for PM-10 analysis. The test results are summarized as follows:

Emission Rates (lb/hr)

	Particulate			
Test run	Filterable PM-10	Condensible PM	Ammonia	Hydrogen sulfide
1	0.92	1.00	0.94	<0.005
2	1.15	0.90	0.62	<0.003
3	2.51	0.84	0.46	0.266
Average	1.53	0.91	0.67	0.091

The raw blood feed rate was 26,300 pounds per hour (lb/hr) during each of the three runs and the dried blood production rate was 2,275 lb/hr during each of the runs. During a major portion of

run 3 of the particulate test, overloading of the process occurred. The results of the particle sizing indicated that the particulate sampled was 100 percent PM-10.

The tests appeared to be conducted using sound methodology with good documentation provided with respect to the test protocol used, the raw data obtained, and supporting calibration data. No operating parameters were provided for the venturi or packed-bed scrubbers. Therefore, the filterable PM-10 data were assigned a quality rating of B. Because the methodology used to obtain condensible PM data was not specified, those data were assigned a C rating. Applicable portions from the test report are provided in Appendix B.

4.1.3 Reference 3

This reference presents the results of a particulate emissions test for the blood dryer at the Farmland Food plant in Iowa Falls, Iowa. The tests were conducted in January, 1987 to provide compliance data for total particulate. Triplicate tests were conducted in the vent stack after a mechanical centrifugal separator. Both filterable and condensible PM were obtained using EPA Method 5. The results of the test are summarized as follows:

	Particulate emission rates, lb/hr	
Test run	Filterable PM	Condensible PM
1	0.12	ND[a]
2	0.051	0.066
3	0.076	0.066
Average	0.082	0.062

[a]ND = no data; data not reported for condensible PM.

The dried blood production rate was 1,030 lb/hr during each of the three runs. No data were presented for condensible PM in run 1.

The results of this emission test were rated C because no raw data sheets, process diagrams, test calibration data, or description of the sampling sites and methodology were provided. Applicable portions from the test report are provided in Appendix C.

4.2 CANDIDATE EMISSION FACTORS

There were no test reports identified that were suitable for the calculation of emission factors for the meat rendering operations. The only test reports containing sufficient data for emission factor estimation were for controlled emissions from a natural gas-direct fired blood dryer. Table 4-1 presents the emission data for PM, hydrogen sulfide (H_2S), and ammonia (NH_3) in terms of weight per 1,000 lb of dried blood meal product. The candidate emission factors based on these data are presented in Table 4-2.

The emission control system in Reference 2 consisted of a cyclone separator for collection of the blood meal product followed by a venturi wet scrubber and three packed bed scrubbers in series. The scrubbing medium for each of the three packed bed scrubbers was a sodium hypochlorite

TABLE 4-1. EMISSION DATA FOR CONTROLLED EMISSIONS FROM BLOOD DRYERS

Pollutant	Emission factor, dried product, lb/ton[a]	Data rating	Reference
Filterable PM-10	1.34 0.16	E E	2 3
Condensible PM	0.80 0.12	E E	2 3
Hydrogen sulfide	0.08	E	2
Ammonia	0.60	E	2

[a]Expressed as weight per unit weight of dried blood meal product.

TABLE 4-2. CANDIDATE EMISSION FACTORS FOR CONTROLLED EMISSIONS FROM BLOOD DRYERS[a]

Pollutant	Emission factor range, lb/ton	Emission factor, lb/ton	Emission factor data rating	Reference
Filterable PM-10	0.16-1.34	0.76	E	2, 3
Condensible PM	0.12-0.80	0.46	E	2, 3
Hydrogen sulfide	NA[b]	0.08	E	2
Ammonia	NA[b]	0.60	E	2

[a]Emission factor units are weight per unit weight of dried blood meal produced.
[b]NA = not applicable; only one test.

solution. The emissions testing was conducted 6 feet upstream from the outlet of the vent stack to the atmosphere.

The emission control system in Reference 3 was a mechanical centrifugal separator. No information was provided for the distance of the testing from the outlet of the separator.

References for Section 4

1. Emission Testing at the Darlings Delaware Rendering Plant, Fresno, CA, prepared for Darlings Delaware Company, Dallas, TX by Genesis Environmental Services Company, July 1990.

2. Blood Dryer Operation Stack Emission Testing, prepared for Milwaukee Tallow Company, Inc., Milwaukee, WI by Environmental Technology and Engineering Corporation, Elm Grove, WI, September 1989.

3. Blood Dryer Particulate Emission Compliance Test, Interpoll Report No. 7-2325, prepared for Farmland Foods, Inc., Iowa Falls, IA by Interpoll Laboratories, Inc., Circle Pines, MN, January 1987.

5. PROPOSED AP-42 SECTION 9.5.3

A proposed AP-42 Section 9.5.3, Meat Rendering Plants, is presented in the following pages as it would appear in the document.

9.5.3 Meat Rendering Plants

9.5.3.1 General[1]

Meat rendering plants process animal by-product materials for the production of tallow, grease, and high-protein meat and bone meal. Plants that operate in conjunction with animal slaughterhouses or poultry processing plants are called integrated rendering plants. Plants that collect their raw materials from a variety of offsite sources are called independent rendering plants. Independent plants obtain animal by-product materials, including grease, blood, feathers, offal, and entire animal carcasses, from the following sources: butcher shops, supermarkets, restaurants, fast-food chains, poultry processors, slaughterhouses, farms, ranches, feedlots, and animal shelters.

The two types of animal rendering processes are edible and inedible rendering. Edible rendering plants process fatty animal tissue into edible fats and proteins. The plants are normally operated in conjunction with meat packing plants under U. S. Department of Agriculture, Food Safety and Inspection Services (USDA/FSIS) inspection and processing standards. Inedible rendering plants are operated by independent renderers or are part of integrated rendering operations. These plants produce inedible tallow and grease, which are used in livestock and poultry feed, soap, and production of fatty-acids.

9.5.3.2 Process Description[1-3]

Raw Materials —

Integrated rendering plants normally process only one type of raw material, whereas independent rendering plants often handle several raw materials that require either multiple rendering systems or significant modifications in the operating conditions for a single system.

Edible Rendering —

A typical edible rendering process is shown in Figure 9.5.3-1. Fat trimmings, usually consisting of 14 to 16 percent fat, 60 to 64 percent moisture, and 22 to 24 percent protein, are ground and then belt conveyed to a melt tank. The melt tank heats the materials to about 43°C (110°F), and the melted fatty tissue is pumped to a disintegrator, which ruptures the fat cells. The proteinaceous solids are separated from the melted fat and water by a centrifuge. The melted fat and water are then heated with steam to about 93°C (200°F) by a shell and tube heat exchanger. A second-stage centrifuge then separates the edible fat from the water, which also contains any remaining protein fines. The water is discharged as sludge, and the "polished" fat is pumped to storage. Throughout the process, direct heat contact with the edible fat is minimal and no cooking vapors are emitted. For this reason, no emission points are designated in Figure 9.5.3-1.

Inedible Rendering —

There are two processes for inedible rendering: the wet process and the dry process. Wet rendering is a process that separates fat from raw material by boiling in water. The process involves addition of water to the raw material and the use of live steam to cook the raw material and accomplish separation of the fat. Dry rendering is a batch or continuous process that dehydrates raw material in order to release fat. Following dehydration in batch or continuous cookers, the melted fat and protein solids are separated. At present, only dry rendering is used in the United States. The wet rendering process is no longer used because of the high cost of energy and of an adverse effect

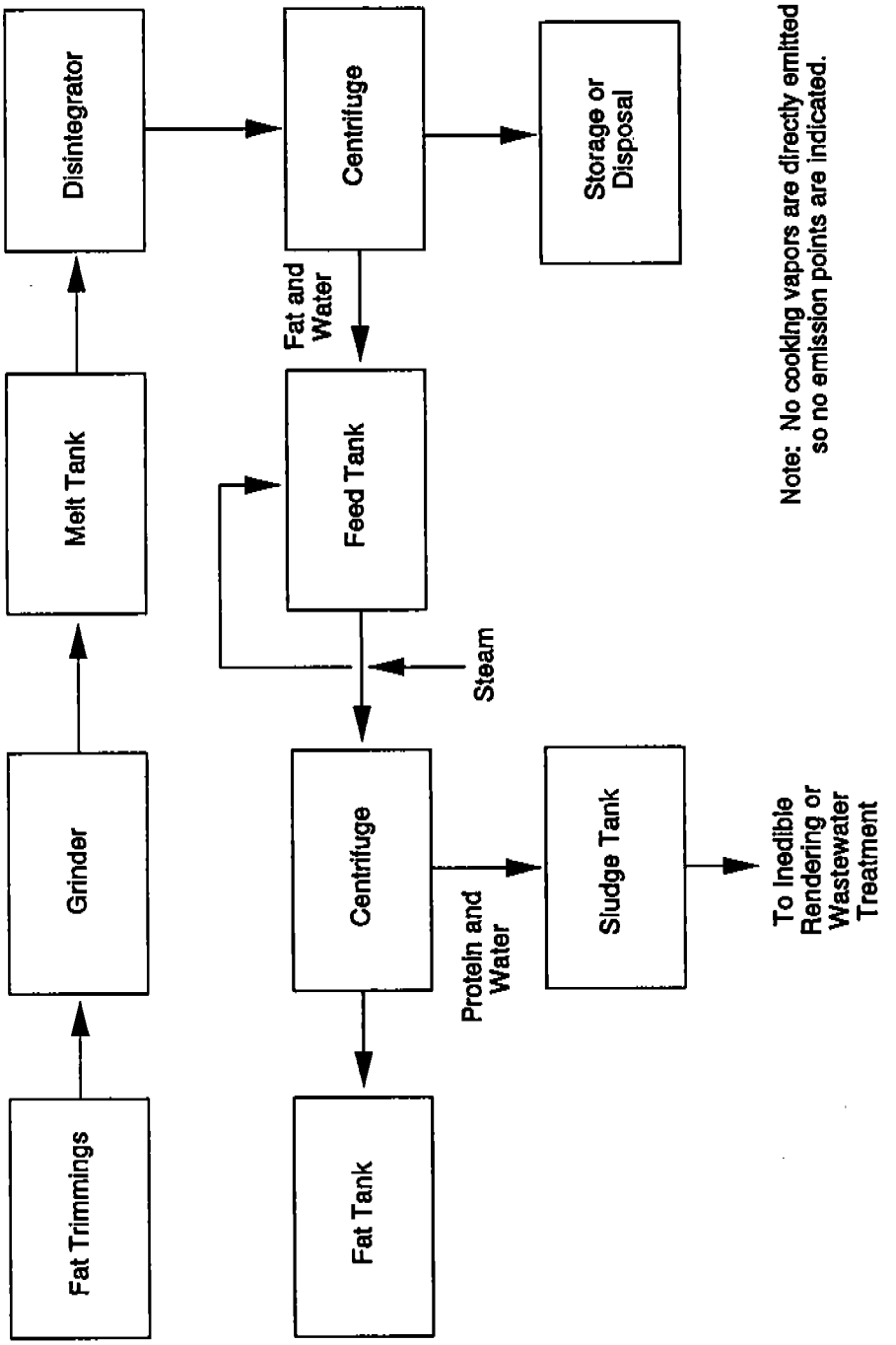


Figure 9.5.3-1. Edible rendering process.

on the fat quality. Table 9.5.3-1 shows the fat, protein, and moisture contents for several raw materials processed by inedible rendering plants.

Batch Rendering Process —

In the batch process, the raw material from the receiving bin is screw conveyed to a crusher where it is reduced to 2.5 to 5 centimeters (cm) (1 to 2 inches [in.]) in size to improve cooking efficiency. Cooking normally requires 1.5 to 2.5 hr, but adjustments in the cooking time and temperature may be required to process the various materials. A typical batch cooker is a horizontal, cylindrical vessel equipped with a steam jacket and an agitator. To begin the cooking process the cooker is charged with raw material, and the material is heated to a final temperature ranging from 121° to 135°C (250° to 275°F). Following the cooking cycle, the contents are discharged to the percolator drain pan. Vapor emissions from the cooker pass through a condenser where the water vapor is condensed and noncondensibles are emitted as VOC emissions.

The percolator drain pan contains a screen that separates the liquid fat from the protein solids. From the percolator drain pan, the protein solids, which still contain about 25 percent fat, are conveyed to the screw press. The screw press completes the separation of fat from solids, and yields protein solids that have a residual fat content of about 10 percent. These solids, called cracklings, are then ground and screened to produce protein meal. The fat from both the screw press and the percolator drain pan is pumped to the crude animal fat tank, centrifuged or filtered to remove any remaining protein solids, and stored in the animal fat storage tank.

Continuous Rendering Process —

Since the 1960, continuous rendering systems have been installed to replace batch systems at some plants. Figure 9.5.3-2 shows the basic inedible rendering process using the continuous process. The system is similar to a batch system except that a single, continuous cooker is used rather than several parallel batch cookers. A typical continuous cooker is a horizontal, steam-jacketed cylindrical vessel equipped with a mechanism that continuously moves the material horizontally through the cooker. Continuous cookers cook the material faster than batch cookers, and typically produce a higher quality fat product. From the cooker, the material is discharged to the drainer, which serves the same function as the percolator drain pan in the batch process. The remaining operations are generally the same as the batch process operations.

Current continuous systems may employ evaporators operated under vacuum to remove moisture from liquid fat obtained using a preheater and a press. In this system, liquid fat is obtained by precooking and pressing raw material and then dewatered using a heated evaporator under vacuum. The heat source for the evaporator is hot vapors from the cooker/dryer. The dewatered fat is then recombined with the solids from the press prior to entry into the cooker/dryer.

Blood Processing And Drying —

Whole blood from animal slaughterhouses, containing 16 to 18 percent total protein solids, is processed and dried to recover protein as blood meal. At the present time, less than 10 percent of the independent rendering plants in the U. S. process whole animal blood. The blood meal is a valuable ingredient in animal feed because it has a high lysine content. Continuous cookers have replaced batch cookers that were originally used in the industry because of the improved energy efficiency and product quality provided by continuous cookers. In the continuous process, whole blood is introduced into a steam-injected, inclined tubular vessel in which the blood solids coagulate. The coagulated blood solids and liquid (serum water) are then separated in a centrifuge, and the blood solids dried in either a continuous gas-fired, direct-contact ring dryer or a steam tube, rotary dryer.

Table 9.5.3-1. COMPOSITION OF RAW MATERIALS FOR INEDIBLE RENDERING[a]

Source	Tallow/Grease, wt %	Protein Solids, wt %	Moisture, wt %
Packing house offal[b] and bone			
Steers	30-35	15-20	45-55
Cows	10-20	20-30	50-70
Calves	10-15	15-20	65-75
Sheep	25-30	20-25	45-55
Hogs	25-30	10-15	55-65
Poultry offal	10	25	65
Poultry feathers	None	33	67
Dead stock (whole animals)			
Cattle	12	25	63
Calves	10	22	68
Sheep	22	25	53
Hogs	30	28	42
Butcher shop fat and bone	31	32	37
Blood	None	16-18	82-84
Restaurant grease	65	10	25

[a] Reference 1.
[b] Waste parts; especially the entrails and similar parts from a butchered animal.

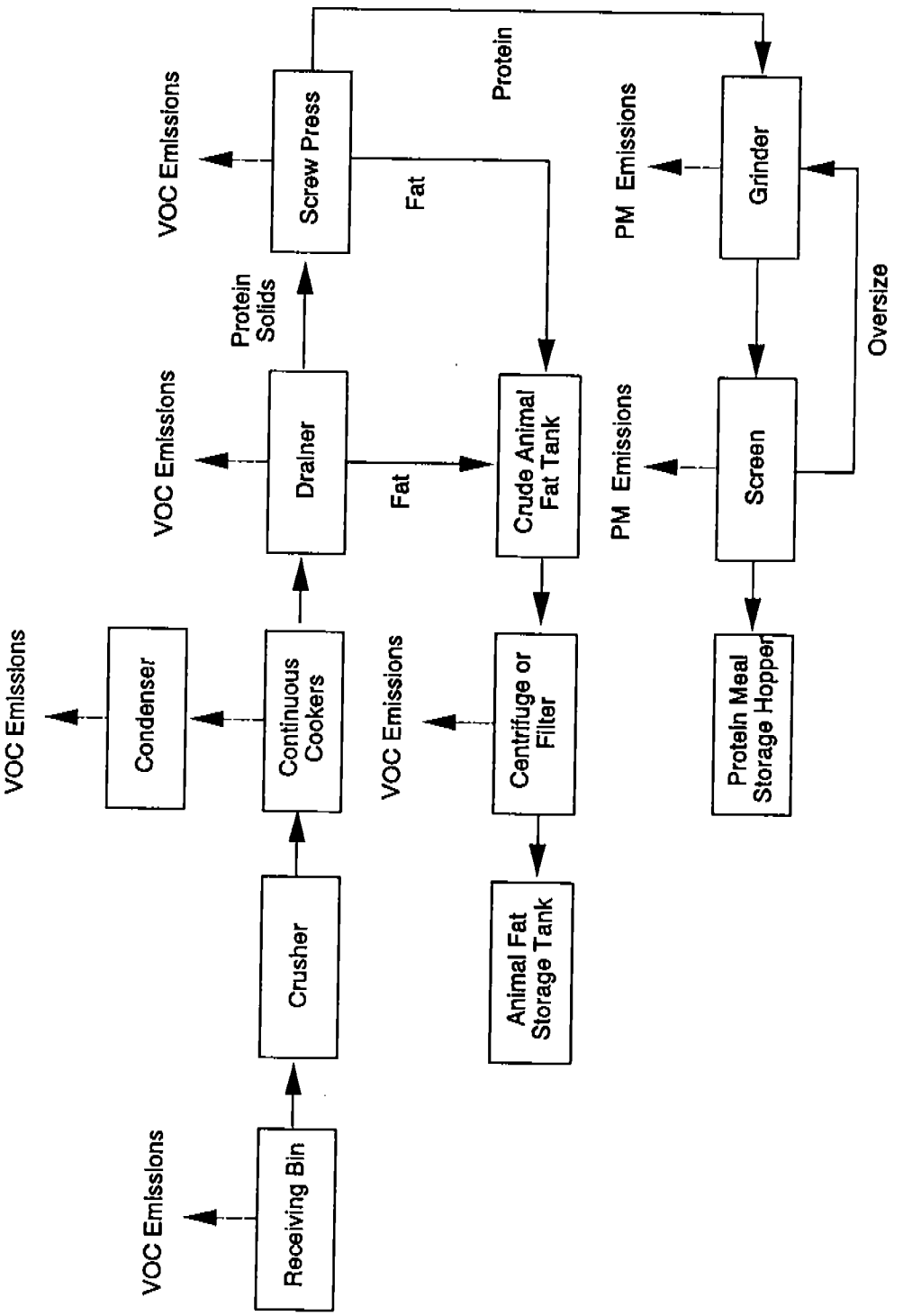


Figure 9.5.3-2. Continuous rendering process.

Poultry Feathers And Hog Hair Processing —

The raw material is introduced into a batch cooker, and is processed for 30 to 45 minutes at temperatures ranging from 138° to 149°C (280° to 300°F) and pressures ranging from (40 to 50 psig). This process converts keratin, the principal component of feathers and hog hair, into amino acids. The moist meal product, containing the amino acids, is passed either through a hot air, ring-type dryer or over steam-heated tubes to remove the moisture from the meal. If the hot air dryer is used, the dried product is separated from the exhaust by cyclone collectors. In the steam-heated tube system, fresh air is passed countercurrent to the flow of the meal to remove the moisture. The dried meal is transferred to storage. The exhaust gases are passed through controls prior to discharge to the atmosphere.

Grease Processing —

Grease from restaurants is recycled as another raw feed material processed by rendering plants. The grease is bulk loaded into vehicles, transported to the rendering plant, and discharged directly to the grease processing system. During processing, the melted grease is first screened to remove coarse solids, and then heated to about 93°C (200°F) in vertical processing tanks. The material is then stored in the processing tank for 36 to 48 hr to allow for gravity separation of the grease, water, and fine solids. Separation normally results in four phases: (1) solids, (2) water, (3) emulsion layer, and (4) grease product. The solids settle to the bottom and are separated from the water layer above. The emulsion is then processed through a centrifuge to remove solids and another centrifuge to remove water and any remaining fines; the grease product is skimmed off the top.

9.5.3.3 Emissions And Controls[1-5]

Emissions —

Volatile organic compounds (VOCs) are the primary air pollutants emitted from rendering operations. The major constituents that have been qualitatively identified as potential emissions include organic sulfides, disulfides, C-4 to C-7 aldehydes, trimethylamine, C-4 amines, quinoline, dimethyl pyrazine, other pyrazines, and C-3 to C-6 organic acids. In addition, lesser amounts of C-4 to C-7 alcohols, ketones, aliphatic hydrocarbons, and aromatic compounds are potentially emitted. No quantitative emission data were presented. Historically, the VOCs are considered an odor nuisance in residential areas in close proximity to rendering plants, and emission controls are directed toward odor elimination. The odor detection threshold for many of these compounds is low; some as low as 1 part per billion (ppb). Of the specific constituents listed, only quinoline is classified as a hazardous air pollutant (HAP). In addition to emissions from rendering operations, VOCs may be emitted from the boilers used to generate steam for the operation.

Emissions from the edible rendering process are not considered to be significant because no cooking vapors are emitted and direct heat contact with the edible fat is minimal. Therefore, these emissions are not discussed further.

For inedible rendering operations, the primary sources of VOC emissions are the cookers and the screw press. Other sources of VOC emissions include blood and feather processing operations, dryers, centrifuges, tallow processing tanks, and percolator pans that are not enclosed. Raw material may also be a source of VOC emissions, but if the material is processed in a timely manner, these emissions are minimal.

In addition to VOC emissions, particulate matter (PM) is emitted from grinding and screening of the solids (cracklings) from the screw press and other rendering operations such as dryers processing blood and feathers. No emission data quantifying VOC, HAP, or PM emissions from the

rendering process are available for use in developing emission factors. Only test data for a blood dryer operation were identified.

Controls —

Emissions control at rendering plants is based primarily on the elimination of odor. These controls are divided into two categories: (1) those controlling high intensity odor emissions from the rendering process, and (2) those controlling plant ventilating air emissions. The control technologies that are typically used for high intensity odors from rendering plant process emissions are waste heat boilers (incinerators) and multistage wet scrubbers.

Boiler incinerators are a common control technology because boilers can be used not only as control devices but also to generate steam for cooking and drying operations. In waste heat boilers, the waste stream can be introduced into the boiler as primary or secondary combustion air. Primary combustion air is mixed with fuel before ignition to allow for complete combustion, and secondary combustion air is mixed with the burner flame to complete combustion. Gaseous waste streams that contain noncondensibles are typically "cleaned" in a combination scrubber and entrainment separator before use as combustion air.

Multistage wet scrubbers are equally as effective as incineration for high intensity odor control and are used to about the same extent as incinerators. Sodium hypochlorite is considered to be the most effective scrubbing agent for odor removal, although other oxidants can be used. Recently, chlorine dioxide has been used as an effective scrubbing agent. Venturi scrubbers are often used to remove PM from waste streams before treatment by the multistage wet scrubbers. Plants that are located near residential or commercial areas may treat process and fugitive emissions by ducting the plant ventilation air through a single-stage wet scrubbing system to minimize odorous emissions.

In addition to the conventional scrubber control technology, activated carbon adsorption and catalytic oxidation potentially could be used to control odor; however, no rendering plants currently use these technologies. Recently, some plants have installed biofilters to control emissions.

No data are currently available for VOC or particulate emissions from rendering plants. The only available data are for emissions from blood dryers, which is an auxiliary process in meat rendering operations. Less than 10 percent of the independent rendering plants in the U. S. process whole blood. Table 9.5.3-2 provides controlled emission factors in English units for particulate matter (filterable and condensible), hydrogen sulfide, and ammonia from natural gas, direct-fired blood dryers. The filterable PM was found to be 100 percent PM-10. Emission factors are calculated on the basis of the weight of dried blood meal product. In addition to natural gas, direct-fired dryers, steam-coil, indirect blood dryers (SCC 3-02-038-12) are also used in meat rendering plants. No emission data were found for this type of dryer. The emission control system in Reference 4 consisted of a cyclone separator for collection of the blood meal product followed by a venturi wet scrubber and three packed bed scrubbers in series. The scrubbing medium for the three packed bed scrubbers was a sodium hypochlorite solution. The emission control system in Reference 5 was a mechanical centrifugal separator.

Table 9.5.3-2. EMISSION FACTORS FOR CONTROLLED BLOOD DRYERS

EMISSION FACTOR RATING: E

Pollutant	Emissions, lb/ton[a]
Filterable PM-10[b] (SCC 3-02-038-11)	0.76
Condensible PM[b] (SCC 3-02-038-11)	0.46
Hydrogen sulfide[c] (SCC 3-02-038-11)	0.08
Ammonia[c] (SCC 3-02-038-11)	0.60

[a] Emission factors based on weight of dried blood meal product. Emissions are for natural gas, direct-fired dryers.
[b] References 4-5.
[c] Reference 4.

References For Section 9.5.3

1. W.H. Prokop, Section on rendering plants, in Chapter 13, "Food And Agriculture Industry", *Air Pollution Engineering Manual*, Van Nostrand Reinhold Press, 1992.

2. H.J. Rafson, *Odor Emission Control For The Food Industry*, Food And Technology, June 1977.

3. *Emission Factor Documentation for AP-42 Section 9.5.3, Meat Rendering Plants*, EPA Contract No. 68-D2-0159, Midwest Research Institute , Kansas City, MO, September 1995.

4. *Blood Dryer Operation Stack Emissions Testing*, Environmental Technology and Engineering Corporation, Elm Grove, WI, September 1989.

5. *Blood Dryer Particulate Emission Compliance Test*, Interpoll Report No. 7-2325, Interpoll Laboratories, Inc., Circle Pines, MN, January 1987.

APPENDIX A

EXCERPTS FROM REFERENCE 1

DARLINGS DELAWARE COMPANY
8737 KING GEORGE DRIVE, SUITE 200
DALLAS, TEXAS 75235

DARLINGS DELAWARE COMPANY
RENDERING PLANT
FRESNO, CALIFORNIA

EMISSION TESTING
JULY 30 & 31,1990

PREPARED BY:
GENESIS ENVIRONMENTAL SERVICES COMPANY
1145 WEST COLUMBUS AVENUE
BAKERSFIELD, CALIFORNIA 93301

REPORT # 7777-0190

TEST CONDUCTED BY MICHAEL L. BAKALOR
RESULTS VERFIED BY MICHAEL L. BAKALOR
OPERATIONS MANAGER

Introduction

At the request of Mr. Mike Koewler of Darlings Daleware Company, Genesis Environmental Services conducted a series of emission tests at Darlings Delaware's rendering plant, located at 2354 Fruit Avenue, Fresno, California.

The purpose of this testing was to determine if a specific group of compounds were present at various point sources in the plant operation process. The four locations and their descriptions are Scrubber #1, a 75K Environmental Research Corporation wet scrubber, Scrubber #2, a 100K Stordbartz wet scrubber and a Waste Heat Incinerator (inlet and outlet), manufactured by Spencer Boiler Manufactures.

The 1990 Annual Compliance Test was conducted on July 30 & 31, 1990, by Mr. Michael Bakalor, Mr. Patrick Young and Mr. Kevin Orton of Genesis Environmental. Darlings Delaware representative Mr. Mike Koewler was present during the testing.

Table 1-1 is contians a summary of results from Scrubber #1 oulet. Table 1-2 contains a summay of results from Scrubber #2 outlet. Table 1-3 contains a summary of results from the Incinerator outlet. Table 1-4 contains a summary of results from the Incinerator inlet. Figure 1-1 contains calculations used to determine the results. The following is a summary of tests performed at Darlings Delaware.

Test Summary
Darlings Delaware
July 30 & 31, 1990

Constituent	Quantity	Analytical Method
Trace Organics	Single	EPA TO-14 GC/MS
Formaldehyde	Single	CARB Method 430
Mercaptans	Single	EPA TO-14 GC/MS
Amines	Single	Gastec Detector Tube
Organic Acids	Single	CARB Method 421
C_2-C_{16} Hydrocarbons	Single	GC/FID

Genesis Environmental performed the sample collection of the above listed constituents. Coast to Coast Analytical Services performed analysis and sample train reagent preparation for the above listed methods.

TABLE 1-1
SUMMARY OF TEST RESULTS
SCRUBBER #1 OUTLET

Trace Organics

Acetone	9.7 ppm
Benzene	< 0.10 ppm
2-Butanone(MEK)	< 0.10 ppm
Chloroethane	< 0.10 ppm
Chloroform	< 0.10 ppm
Chloromethane	< 0.10 ppm
Dichloromethane	< 0.10 ppm
Ethylbenzene	< 0.10 ppm
Toluene	< 0.10 ppm
1,1,1-Trichloroethane	< 0.10 ppm
Trichloroethane(TCE)	< 0.10 ppm
Xylenes	< 0.10 ppm

Organic Acids

Propionic Acid	19.7 ppm

Hydrocarbons C_2 - C_{10}

Ethane	< 10.0 ppm
Propane	< 10.0 ppm
Butane	< 10.0 ppm
Isobutane	< 10.0 ppm
Pentanes	< 10.0 ppm
Hexanes	< 10.0 ppm
C_6 H14 Hexanes	< 1.0 ppm
C_6 H12 Hexanes	< 1.0 ppm
C_7 H16 Heptanes	< 1.0 ppm
C_7 H14 Heptanes	< 1.0 ppm
C_8 H18 Octanes	< 1.0 ppm

Mercaptans
Not Detected

Formaldehydes	< 1.0 ppm

NOTE: All other constituents not listed above are detailed in Appendix A-1, were found to be not detected.

TABLE 1-2
SUMMARY OF TEST RESULTS
SCRUBBER #2 OUTLET

Trace Organics

Acetone	< 0.10 ppm
Benzene	< 0.10 ppm
2-Butanone(MEK)	< 0.10 ppm
Chlorobenzene	< 0.10 ppm
Chloroethane	< 0.10 ppm
Chloroform	< 0.10 ppm
Chloromethane	< 0.10 ppm
Dichloromethane	< 0.10 ppm
Ethylbenzene	< 0.10 ppm
4-Methyl-2-Pentanone(MIBK)	< 0.10 ppm
Steryne	< 0.10 ppm
Toluene	< 0.10 ppm
1,1,1-Trichloroethane	< 0.10 ppm
Xylenes	< 0.10 ppm

Organic Acids

Propionic Acid	11.6 ppm

Hydrocarbons C_2 - C_{10}

Ethane	< 10.0 ppm
Propane	< 10.0 ppm
Butane	< 10.0 ppm
Isobutane	< 10.0 ppm
Pentanes	< 10.0 ppm
Hexanes	< 10.0 ppm
C_6 H14 Hexanes	< 1.0 ppm
C_6 H12 Hexanes	< 1.0 ppm
C_7 H16 Heptanes	< 1.0 ppm
C_7 H14 Heptanes	< 1.0 ppm
C_8 H18 Octanes	< 1.0 ppm

Mercaptans
Not Detected

Formaldehydes < 1.0 ppm

Amines
Not Detected

NOTE: All other constituents not listed above are detailed in Appendix A-1, were found to be not detected.

TABLE 1-3
SUMMARY OF TEST RESULTS
INCINERATOR OUTLET

Trace Organics	
Benzene	0.16 ppm
2-Butanone(MEK)	< 0.10 ppm
Chloroform	< 0.10 ppm
1,2-Dichloroethane	< 0.10 ppm
Ethylbenzene	< 0.10 ppm
Toluene	< 0.10 ppm
Xylenes	< 0.10 ppm
Organic Acids	
Propionic Acid	58.8 ppm
Hydrocarbons C_2 - C_{10}	
Ethane	< 10.0 ppm
Propane	< 10.0 ppm
Butane	< 10.0 ppm
Isobutane	< 10.0 ppm
Pentanes	< 10.0 ppm
Hexanes	< 10.0 ppm
C_6 H14 Hexanes	< 1.0 ppm
C_6 H12 Hexanes	< 1.0 ppm
C_7 H16 Heptanes	< 1.0 ppm
C_7 H14 Heptanes	< 1.0 ppm
C_8 H18 Octanes	< 1.0 ppm
Mercaptans	
Not Detected	
Formaldehydes	< 1.0 ppm
Amines	
Not Detected	

NOTE: All other constituents not listed above are detailed in Appendix A-1, were found to be not detected.

TABLE 1-4
SUMMARY OF TEST RESULTS
INCINERATOR INLET

Trace Organics	
Acetone	1.0 ppm
Benzene	< 0.10 ppm
Bromodichloromethane	< 0.10 ppm
Bromoform	< 0.10 ppm
2-Butanone(MEK)	0.19 ppm
Chlorobenzene	< 0.10 ppm
Chloroform	< 0.10 ppm
Dichloromethane	< 0.10 ppm
Ethylbenzene	< 0.10 ppm
Styrene	< 0.10 ppm
1,1,2,2-Tetrachloroethane	< 0.10 ppm
Toluene	< 0.10 ppm
1,1,1-Trichloroethane	< 0.10 ppm
Xylenes	< 0.10 ppm
Organic Acids	
Propionic Acid	155.8 ppm
Hydrocarbons C_2 - C_{10}	
Ethane	< 10.0 ppm
Propane	< 10.0 ppm
Butane	< 10.0 ppm
Isobutane	< 10.0 ppm
Pentanes	< 10.0 ppm
Hexanes	< 10.0 ppm
C_6 H14 Hexanes	< 1.0 ppm
C_6 H12 Hexanes	< 1.0 ppm
C_7 H16 Heptanes	< 1.0 ppm
C_7 H14 Heptanes	< 1.0 ppm
C_8 H18 Octanes	< 1.0 ppm
Mercaptans	
Not Detected.	
Formaldehydes	< 1.0 ppm
Amines	29.0 ppm

NOTE: All other constituents not listed above are detailed in Appendix A-1, were found to be not detected.

APPENDIX B

EXCERPTS FROM REFERENCE 2

CORRESPONDENCE/MEMORANDUM_____State of Wisconsin

4530

Date: November 14, 1989

To: SED Case File

From: Eileen F. Ingwersen EFI

Subject: Review of Stack Test Conducted at Milwaukee Tallow Co. on September 27, 1989 between 5:55 and 9:42 pm.

Receive 11/6/89

I. Source

Milwaukee Tallow Company
131 South Seventh Street
P.O. Box 1174
Milwaukee, Wisconsin 53233

Mr. Duane Hildreth, Plant Manager
(414) 276-5700

FID# 241043990
Permit# 89-VAR-211, issued on July 7, 1989
Process P10 Stack S10, Blood Dryer
Initial Operation Began on July 12, 1989.

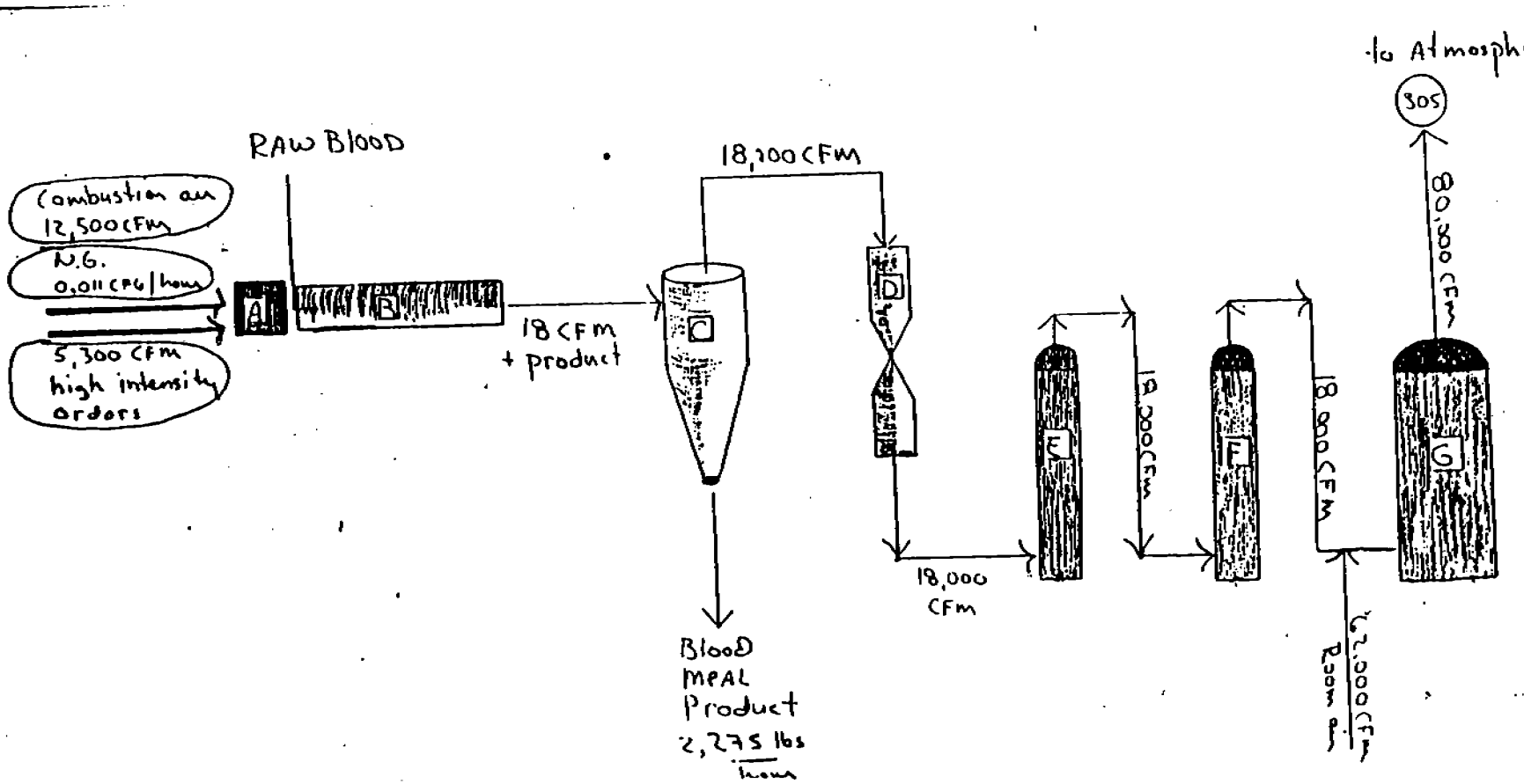
II. Process Description

The source tested is a natural gas fired blood dryer. The maximum capacity of the dryer is 2275 pounds finished product per hour, 26300 pounds raw material per hour. High intensity room odors are vented to the blood dryer burner for incineration. These odor emissions are from the rendering operation and were previously controlled by a wet scrubber. An air/particulate cyclone separator follows the dryer for collection of blood meal product. A venturi wet scrubber and three packed bed scrubbers follow the cyclone in series. A sodium hypochlorite solution is the scrubbing medium for the three packed beds. (See the attached flow diagram.) During this stack test the blood dryer was operated at its rated capacity. The raw pounds input was monitored and maintained within 0.004 percent of 26300 pounds raw material per hour. During a major portion of the third run of the particulate test "overloading" of the process occurred.

III. Sampling Operation

A. Purpose of Test

Part I.B.2 of permit #89-VAR-211 requires that the emissions from the blood dryer be tested for compliance with the PM/PM10, hydrogen sulfide, ammonia, and opacity limits. This permit was issued on July 7, 1989. Initial operation of the blood dryer began on July 12, 1989. A notice of violation



A = furnace
B = Rotary dryer
C = cyclone separator
D = Venturi scrubber
E = 18,000 CFM scrubber ($NaOCl$)
F = 18,000 CFM scrubber ($NaOCl$)
G = 80,000 CFM scrubber ($NaOCl$)

] counter current flow

Milwaukee Tallow
New Blood Dryer
5/4/89
VAR

was issued to Milwaukee Tallow Company on August 4, 1989 for construction of this blood dryer without a permit. No further enforcement action was taken.

B. Sampling Firm

These tests were conducted by Michael J. Huenink of Environmental Technology & Engineering Corp., 13020 West Bluemound Road, Elm Grove, WI 53122, (414) 784-2434.

C. Test Methods

Testing for particulate matter emissions was conducted in accordance with the procedures outlined in EPA Method 5 (40 CFR, Part 60, App. A). A six stage in-stack Cascade Impactor was used to collect a particle size sample for PM10 analysis.

Testing for hydrogen sulfide emissions was conducted in accordance with the procedures outlined in EPA Method 11 (40 CFR, Part 60, App. A).

Testing for ammonia emissions was conducted in accordance with the procedures outlined in NIOSH P & CAM Method 125.

Visible emissions were analyzed in accordance with the procedures outlined in EPA Method 9 (40 CFR, Part 60, App. A).

The PM/PM10 tests were conducted from two ports located in the final discharge stack ten feet downstream from the nearest obstruction, and six feet upstream from the stack outlet. The diameter of the stack is 70 inches. For the PM test twenty four points were sampled for 2.5 minutes per point for each of the three 60 minute runs. For the PM10 particle sizing a two hour test was taken along both traverses of the stack diameter.

The hydrogen sulfide and ammonia tests were conducted from a port just upstream from the PM/PM10 test ports. For each of these tests three 60 minute samples were drawn through a midget impinger train at one litre per minute. The hydrogen sulfide and ammonia tests were performed at the same time as the particulate matter tests.

Visible emissions were observed for one hour during the first run of the PM test. Lack of daylight prevented further readings.

The first run of these tests was witnessed by Marvin Patton, DNR.

IV. Summary of Results

Run#	PM/PM10 #/hr*	Isokinetic %	Hydrogen Sulfide #/hr	Ammonia #/hr	Opacity %
1	1.92	96.61	<0.005	0.94	0.42
2	2.05	97.18	<0.003	0.62	-
3	3.35	97.12	0.266	0.46	-
avg.	2.44	96.97	0.091	0.67	0.42
Permit Limits	0.81	-	8.85	1.95	20

* The results of the particle sizing indicate that all the particulate sampled was less than ten microns in size.

V. Discussion of Results

The results of these tests indicate that Milwaukee Tallow operates this blood dryer in violation of the PM/PM10 emission limit of 0.81 pounds per hour, NR 415.03, Wis. Adm. Code, Permit #89-VAR-211. The test resulta also indicate that this blood drier is operated in compliance with the hydrogen sulfide, ammonia, and visible emission limits. These limits as set in Permit #89-VAR-211, are as follows: 8.85 pounds hydrogen sulfide per hour, NR 445.04(1); 1.95 pounds ammonia per hour, NR 445.04(1); and 20% opacity, NR 431.05(1), Wis. Adm. Code.

The report prepared by ET&E contains calibration data for the sampling equipment and a description of the production levels for the process during the testing. No deviations from standard US EPA testing procedures are noted in the report. The isokinetic ratio during the particulate test is within the 90 to 110% range set by the Department.

T. Rapp 10/14/94
MRI

FEED RATES (ALL 3 RUNS):

RAW BLOOD FEED RATE: 26,300 lbs/hr = 13.15 tons/hr

DRIED BLOOD MEAL PRODUCTION RATE (ALL 3 RUNS):

PRODUCTION RATE = 2,275 lbs/hr = 1.14 tons/hr

c: SED Case File
Joe Perez - AM/3
U.S. EPA Region V

MILW TALLOW - BLOOD DRYER TEST 1 TABLE 2-1 9-27-89

BAROMETRIC PRESSURE, in Hg. = 29.200
TIP DIAMETER, in .2500
STACK AREA, sq ft = 26.730
SAMPLING TIME PER POINT, min = 2.50
NUMBER OF POINTS = 24
GAS METER VOLUME, acf = 52.25
WATER COLLECTED, ml = 13.00
PARTICULATE COLLECTED, grams = 0.0109
CO2 = 0.00 O2 = 20.70 CO = 0.00 N2 = 79.30

SAMPLING POINT	STACK TEMP deg F	PITOT DEL P inches	ORIFICE METER inches	GAS METER OUTLET T deg F	GAS VELOCITY fps
1	65	0.750	2.75	60	49.70
2	65	0.750	2.75	60	49.70
3	65	0.680	2.45	61	47.32
4	65	0.600	2.20	61	44.45
5	65	0.540	1.95	61	42.17
6	65	0.500	1.85	62	40.58
7	65	0.450	1.70	62	38.49
8	65	0.450	1.70	63	38.49
9	65	0.480	1.80	64	39.76
10	65	0.500	1.85	65	40.58
11	65	0.500	1.85	66	40.58
12	65	0.500	1.85	68	40.58
13	60	0.640	2.30	70	45.69
14	60	0.600	2.20	70	44.24
15	60	0.540	1.95	71	41.97
16	65	0.500	1.85	72	40.58
17	65	0.480	1.80	73	39.76
18	60	0.450	1.70	74	38.31
19	60	0.520	1.90	75	41.18
20	65	0.680	2.45	75	47.32
21	65	0.860	3.15	76	53.22
22	60	1.000	3.65	77	57.11
23	65	1.050	3.85	79	58.80
24	65	0.800	2.95	80	51.33
AVG VALUES	64		2.269	69	44.66

TOTAL GAS WITHDRAWN, scf = 52.04
DRY GAS WITHDRAWN, scf = 51.43
WATER VAPOR WITHDRAWN, scf = 0.61
PERCENT WATER VAPOR = 1.18
ACTUAL WET FLOW RATE, acfm = 71,627.06
STANDARD DRY FLOW RATE, scfm = 69,580.65
PARTICULATE CONCENTRATION, grains/dscf = 0.003
PARTICULATE EMISSION RATE, lb/hr = 1.917
PERCENT OF ISOKINETIC SAMPLING = 96.61

MILW TALLOW - BLOOD DRYER TEST 2 TABLE 2-2 9-27-89

BAROMETRIC PRESSURE, in Hg = 29.200
TIP DIAMETER, in .2500
STACK AREA, sq ft = 26.730
SAMPLING TIME PER POINT, min = 2.50
NUMBER OF POINTS = 24
GAS METER VOLUME, acf = 51.70
WATER COLLECTED, ml = 24.00
PARTICULATE COLLECTED, grams = 0.0117
CO2 = 0.00 O2 = 20.70 CO = 0.00 N2 = 79.30

SAMPLING POINT	STACK TEMP deg F	PITOT DEL P inches	ORIFICE METER inches	GAS METER OUTLET T deg F	GAS VELOCITY fps
1	65	0.620	2.30	79	45.27
2	65	0.600	2.25	79	44.53
3	65	0.550	2.00	80	42.64
4	65	0.500	1.85	80	40.65
5	65	0.480	1.80	80	39.83
6	~~60~~	0.460	1.70	81	38.99
7	65	0.460	1.70	81	38.99
8	65	0.720	2.65	81	48.78
9	65	0.880	3.20	81	53.93
10	65	0.980	3.65	81	56.91
11	65	1.050	3.85	81	58.91
12	65	0.880	3.20	81	53.93
13	65	0.700	2.60	82	48.10
14	65	0.680	2.50	83	47.41
15	65	0.680	2.50	83	47.41
16	65	0.580	2.15	83	43.78
17	65	0.580	2.15	83	43.78
18	65	0.500	1.85	84	40.65
19	65	0.460	1.70	84	38.99
20	65	0.460	1.70	84	38.99
21	65	0.460	1.70	84	38.99
22	65	0.460	1.70	84	38.99
23	65	0.440	1.65	84	38.14
24	65	0.500	1.85	84	40.65
AVG VALUES	65		2.258	82	44.55

TOTAL GAS WITHDRAWN, scf = 52.10
DRY GAS WITHDRAWN, scf = 50.97
WATER VAPOR WITHDRAWN, scf = 1.13
PERCENT WATER VAPOR = 2.17
ACTUAL WET FLOW RATE, acfm = 71,455.07
STANDARD DRY FLOW RATE, scfm = 68,552.81
PARTICULATE CONCENTRATION, grains/dscf = 0.004
PARTICULATE EMISSION RATE, lb/hr = 2.052
PERCENT OF ISOKINETIC SAMPLING = 97.18

MILW TALLOW - BLOOD DRYER TEST 3 TABLE 2-3 9-27-89

BAROMETRIC PRESSURE, in Hg = 29.200
TIP DIAMETER, in .2500
STACK AREA, sq ft = 26.730
SAMPLING TIME PER POINT, min = 2.50
NUMBER OF POINTS = 24
GAS METER VOLUME, acf = 51.64
WATER COLLECTED, ml = 23.00
PARTICULATE COLLECTED, grams = 0.0191
CO2 = 0.00 O2 = 20.70 CO = 0.00 N2 = 79.30

SAMPLING POINT	STACK TEMP deg F	PITOT DEL P inches	ORIFICE METER inches	GAS METER OUTLET T deg F	GAS VELOCITY fps
1	65	0.640	2.35	83	45.99
2	65	0.600	2.20	84	44.53
3	65	0.560	2.05	84	43.02
4	65	0.520	1.90	84	41.45
5	65	0.500	1.85	84	40.65
6	65	0.460	1.70	84	38.99
7	65	0.460	1.70	84	38.99
8	65	0.780	2.85	84	50.77
9	65	0.780	2.85	84	50.77
10	65	1.000	3.65	84	57.48
11	65	1.050	3.85	84	58.90
12	65	0.860	3.15	84	53.31
13	65	0.700	2.55	84	48.09
14	65	0.640	2.35	84	45.99
15	65	0.640	2.35	84	45.99
16	65	0.600	2.30	84	44.53
17	65	0.500	1.85	84	40.65
18	65	0.460	1.70	84	38.99
19	65	0.460	1.70	84	38.99
20	65	0.460	1.70	84	38.99
21	65	0.460	1.70	84	38.99
22	65	0.500	1.85	84	40.65
23	65	0.500	1.85	84	40.65
24	65	0.500	1.85	84	40.65
AVG VALUES	65		2.244	84	44.50

TOTAL GAS WITHDRAWN, scf = 52.00
DRY GAS WITHDRAWN, scf = 50.92
WATER VAPOR WITHDRAWN, scf = 1.08
PERCENT WATER VAPOR = 2.08
ACTUAL WET FLOW RATE, acfm = 71,365.50
STANDARD DRY FLOW RATE, scfm = 68,527.41
PARTICULATE CONCENTRATION, grains/dscf = 0.006
PARTICULATE EMISSION RATE, lb/hr = 3.351
PERCENT OF ISOKINETIC SAMPLING = 97.12

LABORATORY DATA SHEET
PARTICULATE & WATER COLLECTED

JOB NAME Milwaukee Tallow DATE OF TEST 9/27/89

JOB NO. 89-1114 TEST ENGINEER MTH

RUN NO. 1 STACK Blood Dryer

SAMPLE BOX 1 FILTER 1152 WASH BOTTLE —

BEAKERS: FH Ace 2FH BH Trichl 9 BH Ace 5 BH H_2O 27

WATER COLLECTED

Impinger No.	Final Wt. - g	Initial Wt. - g	Collected - g
1	93	100	-7
2	107	100	7
3	3	0	3
Sil Gel	631	621	10
		WATER TOTAL	13

PARTICULATE COLLECTED

	Blank	Final Wt.	Tare Wt.	Collected - g
Filter		0.7790	0.7790	0.0000
FH Wash	0.0008	97.6900	97.6840	0.0052
		FILTERABLE TOTAL		0.0052
Extract	0.0005	72.1717	72.1711	<0.0005
Acetone	0.0004	96.4378	96.4350	0.0024
Water	0.0002	109.3523	109.3507 (x2.03)	0.0028
		CONDENSIBLE TOTAL		0.0057
		PARTICULATE TOTAL		0.0109

LABORATORY DATA SHEET
PARTICULATE & WATER COLLECTED

JOB NAME Milwaukee Tallow — DATE OF TEST 9/27/89

JOB NO. 89-1114 — TEST ENGINEER MJH

RUN NO. 2 — STACK Blood Dryer

SAMPLE BOX 2 — FILTER 1153 — WASH BOTTLE —

BEAKERS: FH Ace 9 — BH Trichl 10 — BH Ace 7 — BH H_2O 31

WATER COLLECTED

Impinger No.	Final Wt. - g	Initial Wt. - g	Collected - g
1	86	100	-14
2	120	100	20
3	4	0	4
Sil Gel	641	627	14
		WATER TOTAL	24

PARTICULATE COLLECTED

	Blank	Final Wt.	Tare Wt.	Collected - g
Filter		0.7912	0.7902	0.0010
FH Wash	0.0008	95.7683	95.7620	0.0055
			FILTERABLE TOTAL	0.0065
Extract	0.0005	67.4687	67.4679	<0.0005
Acetone	0.0004	93.8916	93.8890	0.0022
Water	0.0002	111.0807	111.0793 (x2.1)	0.0025
			CONDENSIBLE TOTAL	0.0052
			PARTICULATE TOTAL	0.0117

LABORATORY DATA SHEET
PARTICULATE & WATER COLLECTED

JOB NAME Milwaukee Tallow — DATE OF TEST 9/27/89

JOB NO. 89-N14 — TEST ENGINEER MJH

RUN NO. 3 — STACK Blood Dryer

SAMPLE BOX 3 — FILTER 1154 — WASH BOTTLE —

BEAKERS: PH Ace 24 — BH Trichl 12 — BH Ace 23 — BH H_2O 35

WATER COLLECTED

Impinger No.	Final Wt. - g	Initial Wt. - g	Collected - g
1	98	100	-2
2	94	100	-6
3	20	0	20
Si Gel	679	668	11
		WATER TOTAL	23

PARTICULATE COLLECTED

	Blank	Final Wt.	Tare Wt.	Collected - g
Filter		0.7900	0.7799	0.0101
PH Wash	0.0008	99.0470	99.0420	0.0042
		FILTERABLE TOTAL		0.0143
Extract	0.0005	68.6512	68.6505	<0.0005
Acetone	0.0004	94.3485	94.3443	0.0038
Water	0.0002	110.3795	110.3790 (x2.1)	<0.0005
		CONDENSIBLE TOTAL		0.0048
		PARTICULATE TOTAL		0.0191

MIDWEST RESEARCH INSTITUTE

Project/Acct. No. 4602-03-03 Date/Time Oct. 14, 1994

Project Title MEAT RENDERING AP-42 Emission FACTORS CALCULATIONS

Signature T. LAPP Verified by _____ (signature/date)

Phone Contact ☐ Meeting Notes ☐ Work Sheet ☒

Page 1 of 3

I. PARTICULATE DISTRIBUTION BETWEEN FILTERABLE AND CONDENSIBLE:

RUN #1: TOTAL PARTICULATE = 0.0109 g

FILTERABLE = $\frac{0.0052 g}{0.0109 g}$ = 0.48 = 48%

CONDENSIBLE = $\frac{0.0057 g}{0.0109 g}$ = 0.52 = 52%

RUN #2: TOTAL PARTICULATE = 0.0117 g

FILTERABLE = $\frac{0.0065 g}{0.0117 g}$ = 0.56 = 56%

CONDENSIBLE = $\frac{0.0052 g}{0.0117 g}$ = 0.44 = 44%

RUN #3: TOTAL PARTICULATE = 0.0191 g

FILTERABLE = $\frac{0.0143}{0.0191}$ = 0.75 = 75%

CONDENSIBLE = $\frac{0.0048}{0.0191}$ = 0.25 = 25%

II. PARTICULATE EMISSION RATES

FILTERABLE:

RUN #1: 1.917 ~~1.92~~ lbs/hr * 0.48 = 0.92 lbs/hr

RUN #2: 2.052 lbs/hr * 0.56 = 1.15 lbs/hr

RUN #3: 3.351 lbs/hr * 0.75 = 2.51 lbs/hr

MRI

Condensible:

Run #1 : 1.917 lbs/hr * 0.52 = 1.00 lbs/hr
Run #2 : 2.052 lbs/hr * 0.44 = 0.90 lbs/hr
Run #3 : 3.351 lbs/hr * 0.25 = 0.84 lbs/hr

Particle

III. Emission Factors -- Raw Blood Feed Basis

Particulate: Raw Material Feed Rate = 13.15 tons/hr

Filterable -- Run #1 0.92 lbs/hr / 13.15 tons/hr = 0.070 lbs/ton
Run #2 1.15 lbs/hr / 13.15 tons/hr = 0.084 lbs/ton
Run #3 2.51 lbs/hr / 13.15 tons/hr = 0.191 lbs/ton

Average = $\frac{0.070 + 0.084 + 0.191}{3}$ = 0.115 lbs/ton

Condensible -- Run #1 1.00 lbs/hr / 13.15 tons/hr = 0.076 lbs/ton
Run #2 0.90 lbs/hr / 13.15 tons/hr = 0.068 lbs/ton
Run #3 0.84 lbs/hr / 13.15 tons/hr = 0.064 lbs/ton

Average = $\frac{0.076 + 0.068 + 0.064}{3}$ = 0.069 lbs/ton

Hydrogen Sulfide: Run #1 0.005 lb/hr / 13.15 tons/hr = 0.00038 lbs/ton
Run #2 0.003 lbs/hr / 13.15 tons/hr = 0.00023 lbs/ton
Run #3 0.266 lbs/hr / 13.15 tons/hr = 0.02023 lbs/ton

Average = $\frac{0.00038 + 0.00023 + 0.02023}{3}$ = 0.0069 lbs/ton

AMMONIA: Run #1 0.94 lbs/hr / 13.15 tons/hr = 0.071
Run #2 0.62 / 13.15 = 0.047
Run #3 0.46 / 13.15 = 0.035

Average = $\frac{0.071 + 0.047 + 0.035}{3}$ = 0.051 lbs/ton

EMISSION FACTORS -- Dried Blood Meal Production Basis

PARTICULATE: Dried Blood Meal Production Rate = 1.14 tons/hr

FILTERABLE -- Run #1 0.92 lbs/hr / 1.14 tons/hr = 0.81 lbs/ton
Run #2 1.15 / 1.14 = 1.01 lbs/ton
Run #3 2.51 / 1.14 = 2.20 lbs/ton

Average = $\frac{0.81 + 1.01 + 2.20}{3}$ = 1.34 lbs/ton

CONDENSIBLE -- Run #1 1.00 lbs/hr / 1.14 tons/hr = 0.88 lbs/ton
Run #2 0.90 / 1.14 = 0.79 lbs/ton
Run #3 0.84 / 1.14 = 0.74 lbs/ton

Average = $\frac{0.88 + 0.79 + 0.74}{3}$ = 0.80 lbs/ton

Hydrogen Sulfide: Run #1 0.005 lbs/hr / 1.14 tons/hr = 0.004 lbs/ton
Run #2 0.003 / 1.14 = 0.003 lbs/ton
Run #3 0.266 / 1.14 = 0.233 lbs/ton

Average = $\frac{0.004 + 0.003 + 0.233}{3}$ = 0.08 lbs/ton

Ammonia: Run #1 0.94 lbs/hr / 1.14 lbs/hr = 0.82 lbs/ton
Run #2 0.62 / 1.14 = 0.54 lbs/ton
Run #3 0.46 / 1.14 = 0.40 lbs/ton

Average = $\frac{0.82 + 0.54 + 0.40}{3}$ = 0.59 lbs/ton

APPENDIX C

EXCERPTS FROM REFERENCE 3

TABLE 1. Summary of the Results of the January 16, 1987, Particulate Emission Compliance Test on the Blood Dryer Stack at the Farmland Foods Plant Located in Iowa Falls, Iowa.

ITEM		Run 1	Run 2	Run 3
Date of test		01-16-87	01-16-87	01-16-87
Time runs were done	(HRS)	746/ 848	920/1022	1047/1148
Process Weight (Dry)	(LB/HR)	1030	1030	1030
Volumetric flow				
actual	(ACFM)	2988	3038	2926
standard	(DSCFM)	1839	1835	1790
Gas temperature	(DEG-F)	193	200	202
Moisture content	(%V/V)	24.42	25.13	23.93
Gas composition	(%V/V,dry)			
carbon dioxide		1.40	2.00	1.80
oxygen		18.80	17.80	18.20
carbon monoxide		0.00	0.00	0.00
nitrogen		79.80	80.20	80.00
Isokinetic variation	(%)	104.7	101.5	98.6
Particulate concentration				
actual	(GR/ACF)	.00483	.00424	.00545
standard	(GR/DSCF)	.00784	.00703	.00891
Part. emission rate	(LB/HR)	0.12	0.11	0.14

* Run 1 - Dry catch only; Runs 2 & 3 - Dry plus organic wet catch

Test No. 1
Blood Dryer Stack

3.1 **Results of Orsat & Moisture Analyses——Methods 3 & 4( )**

Date of run	Run 1 01-16-87	Run 2 01-16-87	3 01- 87
Dry basis (orsat)			
carbon dioxide.....	1.40	2.00	30
oxygen.....	18.80	17.80	20
carbon monoxide.....	0.00	0.00	00
nitrogen.....	79.80	80.20	80.00
Wet basis			
carbon dioxide.....	1.06	1.50	37
oxygen.....	14.21	13.33	95
carbon monoxide.....	0.00	0.00	.00
nitrogen.....	60.31	60.04	86
water vapor.....	24.42	25.13	23.93
Dry molecular weight.....	28.98	29.03	29.02
Wet molecular weight.....	26.30	26.26	26.38
Specific gravity.....	0.908	0.907	0.911
Water mass flow.....(LB/HR)	1669	1728	1579

FO 1.500 1.500 1.500

Test No. 1
Blood Dryer Stack

3.2 Results of Particulate Loading Determinations--------Method 5

	Run 1	Run 2	Run 3
Date of run	01-16-87	01-16-87	01-16-87
Time run start/end.....(HRS)	746/ 848	920/1022	1047/1148
Static pressure.....(IN.WC)	0.32	0.32	0.32
Cross sectional area (SQ.FT)	0.92	0.92	0.92
Pitot tube coefficient.....	.840	.840	.840
Water in sample gas			
condenser.....(ML)	220.0	0.0	0.0
impingers.....(GRAMS)	0.0	265.0	229.0
desiccant.....(GRAMS)	73.0	29.0	32.0
total.....(GRAMS)	293.0	294.0	261.0
Total particulate material collected(grams)	0.0217	0.0188	0.0226
Gas meter coefficient.....	1.0083	1.0093	1.0083
Barometric pressure..(IN.HG)	30.13	30.13	30.13
Avg. orif.pres.drop..(IN.WC)	1.53	1.45	1.32
Avg. gas meter temp..(DEF-F)	72.5	82.1	84.5
Volume through gas meter....			
at meter conditions...F)	42.27	41.62	39.63
standard conditions.(DSCF)	42.70	41.29	39.13
Total sampling time....(MIN)	60.00	60.00	60.00
Nozzle diameter.....(IN)	.250	.250	.250
Avg.stack gas temp ..(DEG-F)	193	200	202
Volumetric flow rate.....			
actual.....(ACFM)	2988	2953	2926
dry standard.....(DSCFM)	1839	1835	1790
Isokinetic variation.....(%)	104.7	101.5	98.6
Particulate concentration...			
actual.....(GR/ACF)	0.00483	0.00424	0.00545
dry standard.....(GR/DSCF)	0.00784	0.00703	0.00891
Particle mass rate...(LB/HR)	0.12	0.11	0.14

PARTICULATE EMISSION TEST

Rend Lq. #2 OPERATING DATA *

(Type of Source)

Owner Farmland Foods Inc. Run No. 1, 2, 3

Source I.D. 42-01-006 Date 1-16-87

Maximum Continuous Process Weight (Manufacturer's Rating) 1500 Lbs./Hr.

Historical Average Process Weight 1030 Lbs./Hr.

Historical Maximum Process Weight 1075 Lbs./Hr.

Type and Sources of Fuels Normally Burned Natural Gas

Approximate Quantities of Each of Above Fuels Burned Annually 30,000 MCF

Recycling Capability: Yes ____ No ✓

Process Data During Run (Averaged)

Process Weight (Dry) 1030 Lbs./Hr.

Percent Moisture 10% %

Process Weight (Wet) 2300 Lbs./Hr.

How Process Weight Determined Based on 680 hogs killed per hour at 8 pounds of raw blood per hog. Number of hogs killed/hr limited to 690/hr by union contract.

Type of Fuel Burned During Run Natural Gas

Recycling in Progress: Yes ____ No ✓

Person Responsible for Data: Thomas D. Beckman

Signature: Thomas D. Beckman

Title/Position: Maint. Supervisor

*Averages of operating data taken during actual test run unless requested otherwise.

AIR POLLUTION CONTROL EQUIPMENT OPERATING DATA*

Plant Farmland Foods Inc Location Iowa Falls, Ia 50126

Source Type Blood Drying Rated Production 1500 Process Pounds/Hr.

Date 1-16-87 Time _____ Actual Production 1030 Process Pounds/Hr

Air Flow Data _____ Run No. 1, 2, 3

Mechanical Collecter:

Tube Diameter 14 in. No. of Tubes 1. Design Δp. 9 in. H_2O @ Gas Temp. 200 F.

Observed Δp _____ in H_2O. Design cfm/tube @ Observed Δp _____ @ _____ °F.

Fan Rated H.P. _____. Operating Volts _____. Operating Amps _____.

Electrostatic Precipitator:

Field No.	Primary Voltage (volts)	Primary Current (amps)	Secondary Voltage (KV)	Secondary Current (ma)	Spark Rate (per min.)

Scrubber:

Type _____. Δp (across scrubber) _____ in. H_2O.

Fan Rated H.P. _____. Operating Volts _____. Operating Amps _____.

Liquid Circulation Rate _____ gal/min. % Make-up _____. Blowdown _____ gpm.

Scrubbing Water Change Interval _____.

Settling Tank Cleaning Interval _____.

Baghouse:

Pressure-Positive _____ Negative _____. No Compartments _____.

Type Cleaning _____. Clean Cycle _____ min.

Avg. Baghouse Δp _____ in H_2O. Δp Range _____ in. H_2O.

Fan: Rated H.P. _____. Operating Volts _____. Operating Amps _____.

Cyclone:

Type Helicone Δp 9" in. H_2O. Diameter 37" OD, 14" Inlet

Fan Rated H.P. 30. Operating Volts 480. Operating Amps _____.

Person Responsible for Data: Thomas D. Buchanan

Signature: Thomas D. Buchanan

Title/Position: Maint. Supervisor

*Averages of operating data taken during actual test run unless requested otherwise.

(EPA Method 5) Impinger Wash (Wet Catch)
Gravimetric Analysis Lab: Organics/Inorganics

Date of Analysis 2-09-87 Data Sheet TR 42(160)

Technician RCV

Project No. _____

Special Handling _____

interpoll

Job _____ Date _____
City/State _____ J/N _____
Source _____
Test Site _____
Sample Type _____ Tech _____
Remarks: Test/Run _____
_____ of _____

☐ Organics
Evap. Dish No. _____
Blk. (Solv) Wt. _____ g
E. Dish Tare Wt. _____ g
E. Dish + Sample Wt. $_{2}$ _____ g
$_{3}$

☐ Inorganics
Evap. Dish No. _____
E. Dish Tare Wt. _____ g
E. Dish + Sample Wt. $_{1}$ _____ g
$_{2}$

Comments _____

760.7
795.9

interpoll

Job Farmland Foods/Iowa Falls Date 1-16-87
City/State Iowa Falls IA Log #4466-11
Source Blood Dryer
Test Site stack
Sample Type Wet Catch Tech JB
Remarks: Test/Run 1/2

Special Handling _____

☑ Organics
Evap. Dish No. 43
Blk. (Solv) Wt. 0.0019 g
E. Dish Tare Wt. 92.3247 g
E. Dish + Sample Wt. $_{3}$ 92.3368 g

☐ Inorganics
Evap. Dish No. _____
E. Dish Tare Wt. _____ g
E. Dish + Sample Wt. $_{2}$ _____ g

Comments .0121 gm

760.7
795.9

interpoll

Job Farmland Foods/Iowa Falls Date 1-16-87
City/State Iowa Falls IA Log #4466-12
Source Blood Dryer
Test Site stack
Sample Type Wet Catch Tech JB
Remarks: Test/Run 1/3
_____ of _____

Special Handling _____

☑ Organics
Evap. Dish No. 47
Blk. (Solv) Wt. 0.0019 g
E. Dish Tare Wt. 92.4713 g
E. Dish + Sample Wt. $_{3}$ 92.4837 g

☐ Inorganics
Evap. Dish No. _____
E. Dish Tare Wt. _____ g
E. Dish + Sample Wt. $_{2}$ _____ g

Comments .0124 gm

ULTS:

	1	2	3
ORGANICS		0.0102	0.0105
INORGANICS			

L-01886

INTERPOLL INC.
EPA Method 5 Probe (Cyclone) Wash
Gravimetric Analysis Laboratory Data Sheet
(CFR Title 40 Part 60 Appendix A)

Date of Analysis 1-22-87
Technician RCV

EPA-M5 Acetone R.B SPEC ≤ 7.8 µg/cc
Actual acetone residue blank 0 µg/cc

(1) Interpoll
Job Ford Steel Rock Falls Date 1-16-87
City/State Rock Falls Log # 4466-02
Source Steel Dryer
Test Site Stack
Sample type PW Tech JB
Remarks: Test/Run 1/1
of

Special Handling Required
Evaporating Dish No. 59
Volume of acetone 105 cc
E. Dish Tare Wt. 105.5931 g
E. Dish + Sample Wt. 105.7143 g
Comments

(2) Interpoll
Job Ford Steel Rock Falls Date 1-15-87
City/State Rock Falls Log # 4466-05
Source Steel Dryer
Test Site Stack
Sample type PW Tech RB
Remarks: Test/Run 1/2
of

Special Handling Required
Evaporating Dish No. 54
Volume of acetone 120 cc
E. Dish Tare Wt. 93.2591 g
E. Dish + Sample Wt. 93.2693 g
Comments

(3) Interpoll
Job Ford Steel Rock Falls Date 1-14-87
City/State Rock Falls Log # 4466-08
Source Steel Dryer
Test Site Stack
Sample type PW Tech JB
Remarks: Test/Run 1/3
of

Special Handling Required
Evaporating Dish No. 58
Volume of acetone 115 cc
E. Dish Tare Wt. 92.2579 g
E. Dish + Sample Wt. 92.2698 g
Comments

RESULTS:

0.0312 g/ 0.0082 g/ 0.011 g

L-0185/Y

(EPA Method 5) Filter
Gravimetric Analysis Lab
Data Sheet
FR 42(160)

Date of Analysis 1-26-87
Technician Bai

(1)

interpoll
Job Farmland Foods Date 1-15-87
City/State Log# 4466-03
Source Blood Dryer
Test Site Stack
Sample type Tech JB
Remarks:
Test/Run 1/1
1 of 1

Special Handling Required
Filter No. 6446
Filter Type 4"G
Filter Tare Wt. 0.6546 g
Filter + Sample Wt. 0.6551 g
Comments

(2)

interpoll
Job Farmland Foods Date 1-16-87
City/State Log# 4466-06
Source Blood Dryer
Test Site Stack
Sample type Tech JB
Remarks:
Test/Run 1/2
1 of 1

Special Handling Required
Filter No. 6450
Filter Type 4"G
Filter Tare Wt. 0.6437 g
Filter + Sample Wt. 0.6441 g
Comments

(3)

interpoll
Job Farmland Foods Date 1-16-87
City/State Log# 4466-09
Source Blood Dryer
Test Site Stack
Sample type Tech JB
Remarks:
Test/Run 1/3
1 of 1

Special Handling Required
Filter No. 6451
Filter Type 4"G
Filter Tare Wt. 0.6464 g
Filter + Sample Wt. 0.6466 g
Comments

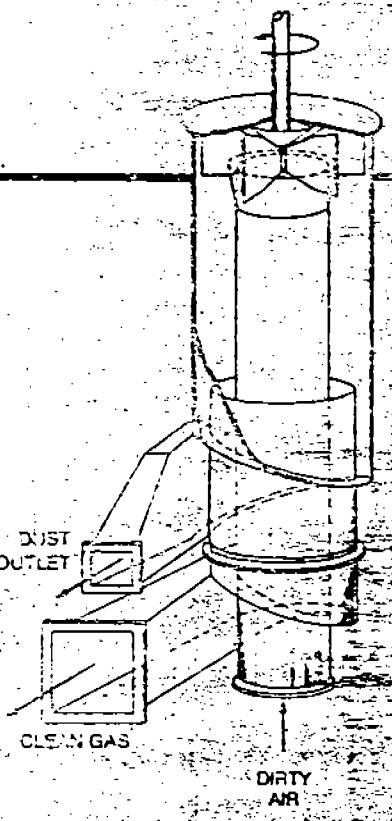
RESULTS:

0.0005	0.0004	0.0002
0.0217	D-8 0.0185	0.0226

L-0185/P

Ref. Farmland Foods Inc.

HELICLONE™ SEPARATOR



JAN - 9 1987

The HELICLONE™ Separator is a mechanical centrifugal separator employing the principle of dynamic precipitation.

It combines the dual functions of air mover and dust separator. The central inlet tube directs particle laden gases into a fan wheel which imparts centrifugal motion to the gases at approximately its tip speed.

Gases are then spun into an outer cylindrical shell where the air borne particles have sufficient residence time in the very high centrifugal force field to migrate to the shell from which they are skimmed off with approximately 15% of the conveying gases, into an annular opening, to a dust receiver. From there the conveying gases can either be recycled to the inlet of the HELICLONE™ or they can be exhausted.

Inward gases of the annular skimming opening are clean and can either be exhausted or directed to a secondary cleaning stage such as a filter which in many instances allows air to recycle into the work area.

Mechanical parts of the HELICLONE™ such as fan wheel, shaft, bearings, etc. are in most cases of standard industrial design. Therefore, the same considerations regarding spark resistant design, high temperature application, etc. apply as in the case of fans.

The name of the HELICLONE® Separator is derived from the shape of the outlet housings, which have helical sides. The helical contour is used for expanding the outlet area.

The helical shape of the housing gives great rigidity to the support of the central feeder tube and the skimming tube. The pitch of the helix essentially follows the pitch of the spinning gases and thus gradually changes their axial flow component into a direction completely perpendicular to the longitudinal axis of the HELICLONE® Separator.

In the vertical position, the separator can be used as a wet scrubber with the water spray centered into the fan wheel.

The helical design of the outlet housings allows drainage of the scrubbing water by gravity. The wet surfaces of the fan wheel and of the cylindrical shell capture the dust particles. From there they are directed into a small sludge receiver cyclone. The HELICLONE® then performs as a mist demister in this case.

The HELICLONE® Separator has a low space requirement and since it is factory assembled, it also has a low installation cost. It is of rugged construction and is available in a variety of sizes ranging from 500 CFM to 50,000 CFM capacity.

MIDWEST RESEARCH INSTITUTE

Project/Acct. No. 4602-03-03 Date/Time MARCH 22, 1995

Project Title MEAT RENDERING AP-42 EMISSION FACTOR CALCULATIONS

Signature T. LAPP Verified by _____ (signature/date)

Phone Contact ☐ Meeting Notes ☐ Work Sheet ☒

I. PARTICULATE DISTRIBUTION between FILTERABLE & CONDENSIBLE:

RUN #1: FILTERABLE ONLY 0.0217 g

RUN #2: FILTERABLE = $\frac{0.0086}{0.0188}$ = 0.457 = 46 %

TOTAL = 0.0188 g

CONDENSIBLE = $\frac{0.0102}{0.0188}$ = 0.543 = 54 %

RUN #3: FILTERABLE = $\frac{0.0121}{0.0226}$ = 0.535 = 53 %

TOTAL = 0.0226 g

CONDENSIBLE = $\frac{0.0105}{0.0226}$ = 0.465 = 47 %

II. PARTICULATE EMISSION RATES

FILTERABLE

RUN #1: 0.12 lb/hr

RUN #2: 0.11 lb/hr * 0.46 = 0.051 lb/hr

RUN #3: 0.14 lb/hr * 0.53 = 0.074 lb/hr

CONDENSIBLE

RUN #2: 0.11 lb/hr * 0.54 = 0.059 lb/hr

RUN #3: 0.14 lb/hr * 0.47 = 0.066 lb/hr

TOTAL PARTICULATE EMISSION RATES

RUN 1 = 0.12 lb/hr

RUN 2 = 0.11 lb/hr

RUN 3 = 0.14 lb/hr

III. EMISSION FACTORS -- DRIED BLOOD MEAL PRODUCTION BASIS

PRODUCTION RATE = 1,030 lbs/hr = 0.515 ton/hr (ALL 3 RUNS)

FILTERABLE

RUN #1: 0.12 lb/hr / 0.515 ton/hr = 0.23 lbs/ton

RUN #2: 0.051 lb/hr / 0.515 ton/hr = 0.099 lbs/ton

RUN #3: 0.074 lb/hr / 0.515 ton/hr = 0.14 lb/ton

AVERAGE 0.16 lbs/ton

MIDWEST RESEARCH INSTITUTE

Project/Acct. No. 4602-03-03 Date/Time MARCH 27, 1995

Project Title MEAT RENDERING AP-42 EMISSION FACTOR CALCULATIONS

Signature TLAPP Verified by _____ (signature/date)

Phone Contact ☐
Meeting Notes ☐
Work Sheet ☒

Condensible

Run #2: 0.059 lbs/hr / 0.515 tons/hr = 0.11 lbs/ton

Run #3: 0.066 lbs/hr / 0.515 tons/hr = 0.13 lbs/ton

AVERAGE 0.12 lbs/ton

MRI