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

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Research Triangle Park, NC 27711

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NOTICE

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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.

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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.

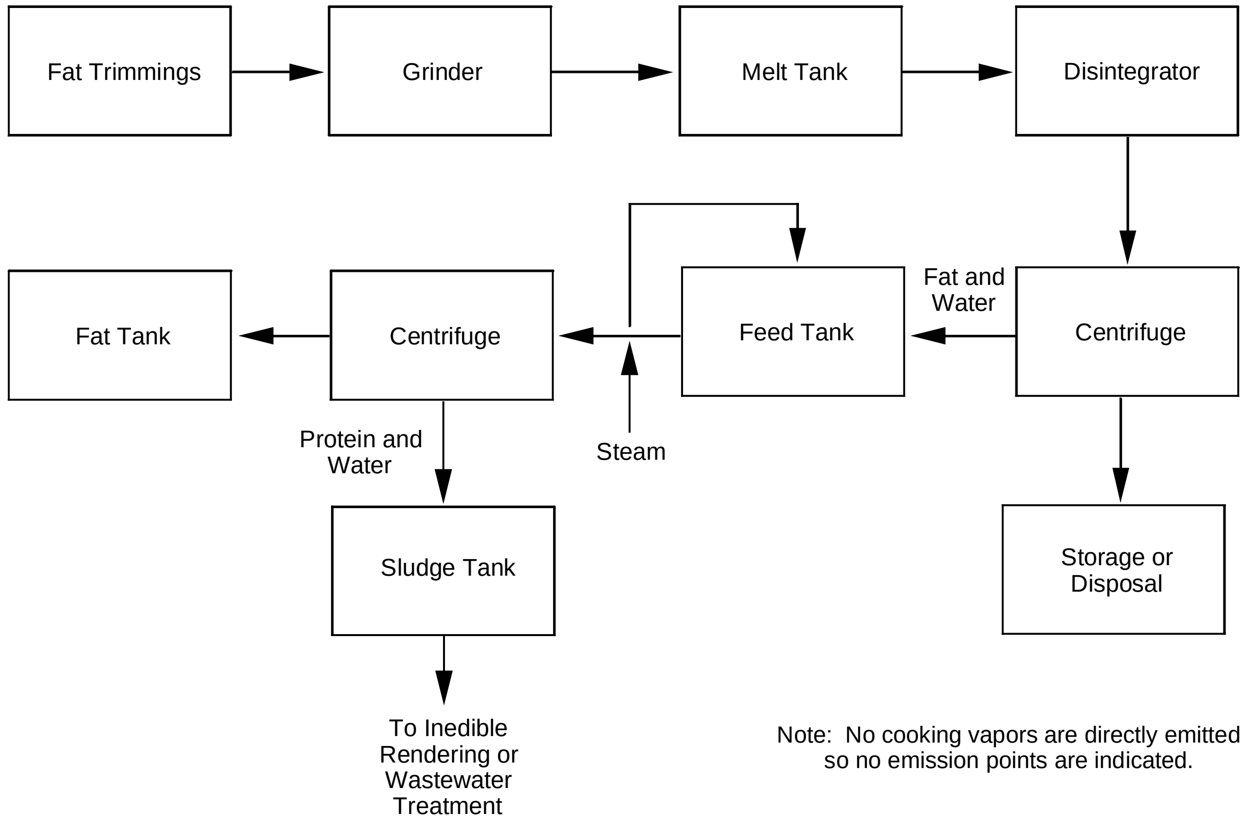

Figure 2-1. Edible rendering process.

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 system, termed waste-heat

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.

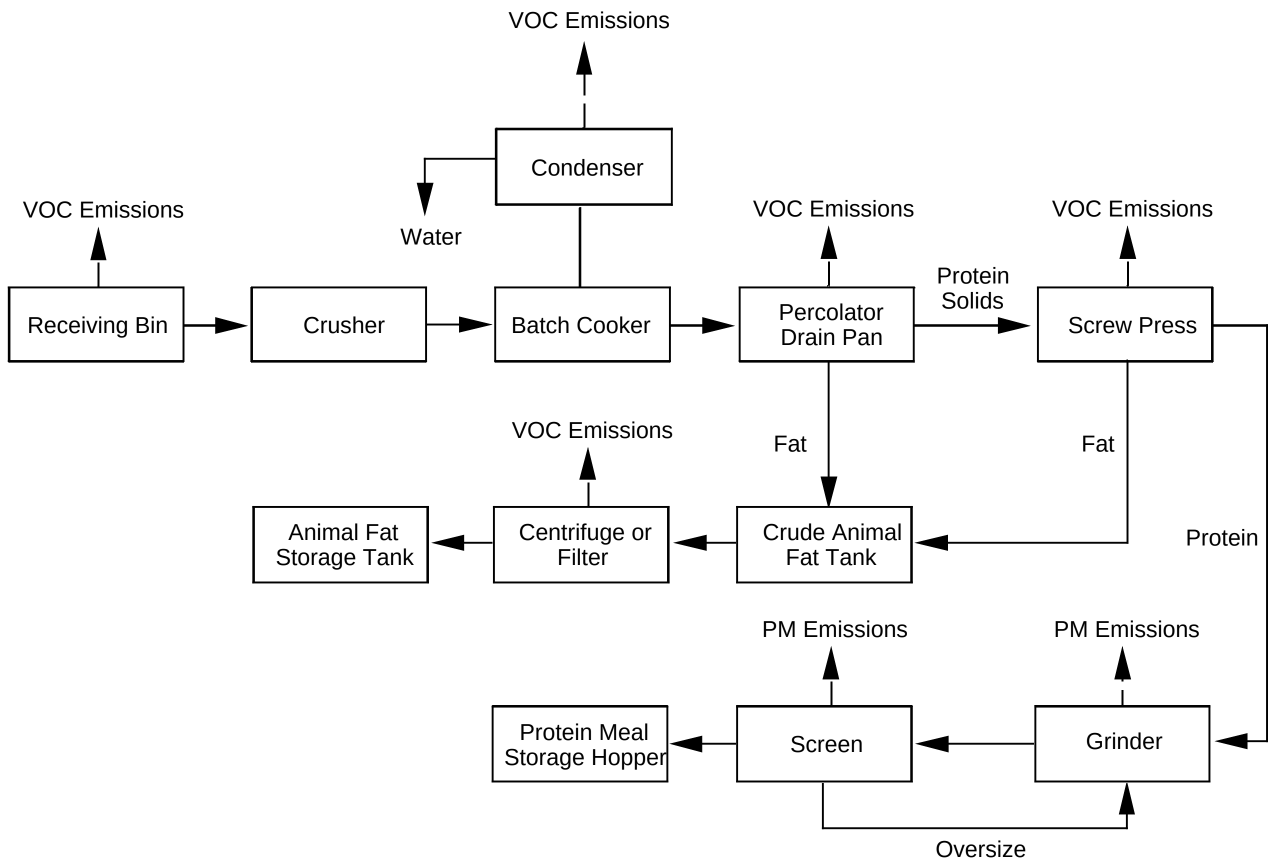

Figure 2-2. Batch cooker rendering process.

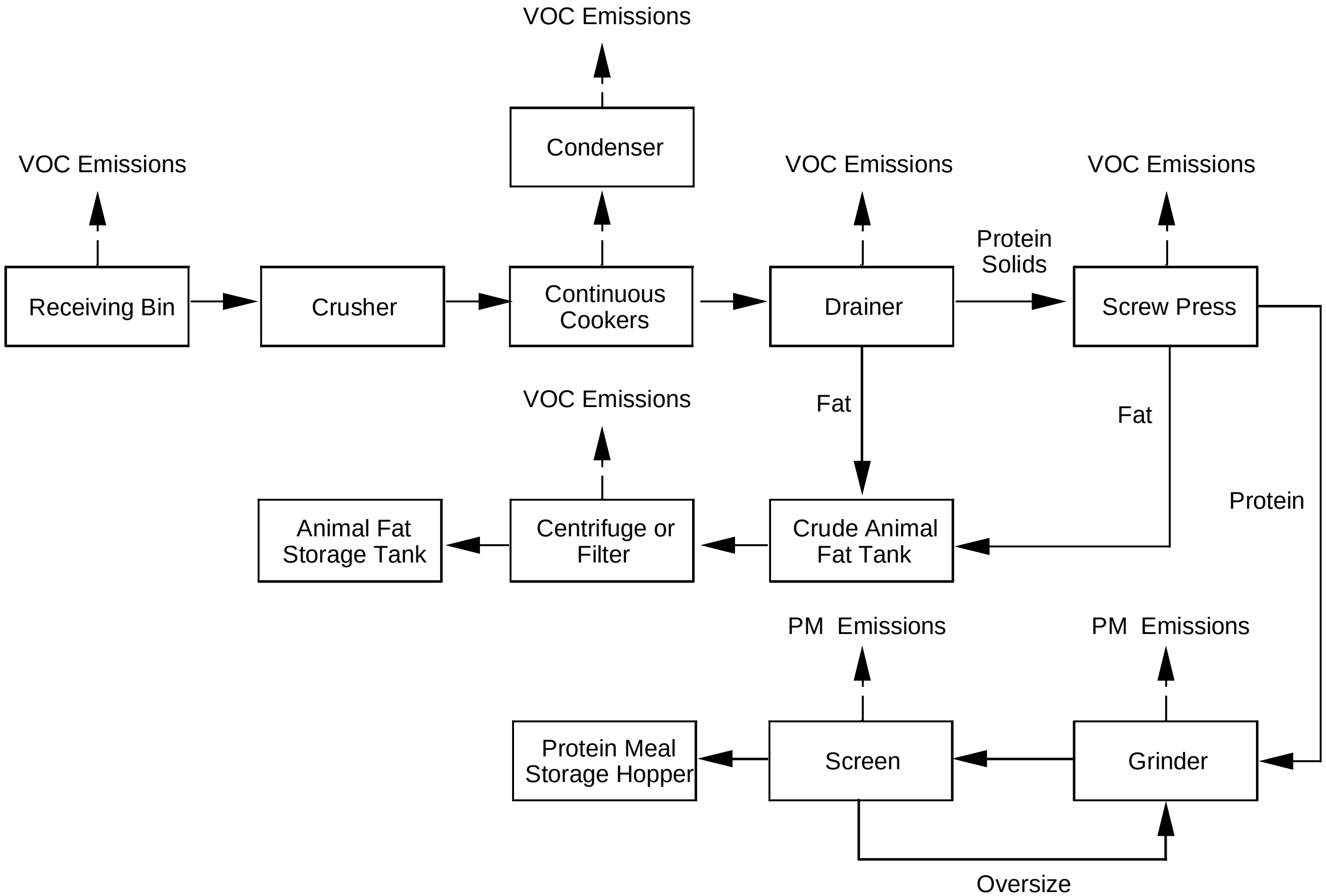

Figure 2-3. Continuous rendering process.

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.

* 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

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.

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 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.

[Not presented here. See instead final AP-42 Section 9.5.3]