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Emission Factor Documentation for AP-42
Section 9.9.4

Alfalfa Dehydration

Final Report

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

EPA Contract 68-D2-0159
Work Assignment No. 3-01 and 4-04

MRI Project No. 4603-01-03 and 4604-04

September 1996

Emission Factor Documentation for AP-42 Section 9.9.4

Alfalfa Dehydration

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

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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 Contract No. 68-D2-0159, Work Assignment No. 3-01 and 4-04. Mr. Dallas Safriet was the requester of the work.

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September, 1996

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EMISSION FACTOR DOCUMENTATION FOR AP-42 SECTION 9.9.4
Alfalfa Dehydration

1. INTRODUCTION

The document *Compilation of Air Pollutant Emission Factors* (AP-42) has been published by the U. S. Environmental Protection Agency (EPA) since 1972. Supplements to AP-42 have been routinely published to add new emission source categories and to update existing emission factors. AP-42 is routinely updated by EPA to respond to new emission factor needs of EPA, 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 report is to provide background information from test reports and other information to support revisions to AP-42 Section 6.1, Alfalfa Dehydrating.

This background report consists of five sections. Section 1 includes the introduction to the report. Section 2 gives a description of the alfalfa dehydration industry. It includes a characterization of the industry, a description of the different process operations, a characterization of emission sources and pollutants emitted, and a description of the technology used to control emissions resulting from these sources. Section 3 is a review of emission data collection (and emission measurement) procedures. It describes the literature search, the screening of emission data reports, and the quality rating system for both emission data and emission factors. Section 4 details emission factor development for alfalfa dehydration. It includes the review of specific data sets and a description of how candidate emission factors were developed. Section 5 presents the AP-42 Section 9.9.4, Alfalfa Dehydration. Supporting documentation for the emission factor development is presented in the Appendices.

2. INDUSTRY DESCRIPTION

This section provides a brief review of the trends in the alfalfa dehydration industry and an overview of the alfalfa dehydration process. Possible emissions and emission control technologies are also provided.

2.1 INDUSTRY CHARACTERIZATION[1-5]

Alfalfa dehydration (SIC 2048) is the rapid drying of freshly cut alfalfa by artificial means. The resulting product is processed into pellets or meal and is sold as livestock feed, such as chicken rations, cattle feed, hog rations, sheep feed, turkey mash, and other formula feeds. Dehydrated alfalfa is important for its protein content, growth and reproductive factors, pigmenting xanthophylls, and vitamin contributions.

Although information is not available for dehydrated alfalfa production alone, approximately 480,500 tons of dehydrated and sun cured alfalfa were produced in the United States in 1992. Mills located east of the Rocky Mountains produce 96 percent (461,800 tons) annually of the total dehydrated and sun cured alfalfa; the remaining 4 percent (18,700 tons) is produced west of the Rocky Mountains. Table 2-1 shows the number of alfalfa dehydrators by State. The annual production of dehydrated and sun cured alfalfa has declined steadily over the past twenty years, with annual productions of 1,992,400 tons in 1972; 1,292,700 tons in 1982; and 480,500 tons in 1992.

TABLE 2-1. DEHYDRATED AND SUN CURED ALFALFA FACILITIES[4]

Area	No. of plants[a]
Nebraska	19
Kansas	9
Utah, Idaho, Oregon	3
Iowa, Minnesota, South Dakota	5
Colorado, Oklahoma, New Mexico, Texas	4
Missouri, Arkansas	2
Ohio, New York	5
Total	47

[a]Includes only the number of plants reporting to the USDA.

2.2 PROCESS DESCRIPTION[1-2,5]

The operation of alfalfa dehydrating mills is seasonal and the typical plant operates continuously 24 hours per day, 7 days per week during the May to October harvest season. The mature alfalfa is harvested by windrow wilting and then chopped out of the windrow with a forage harvester and hauled as soon as possible to the dehydrating plant.

2.2.1 Alfalfa Dehydration

Figure 2-1 presents a general diagram for a typical alfalfa dehydrator plant. Standing alfalfa is windrowed in the field to allow wilting to reduce moisture to an acceptable level balancing energy requirements, trucking requirements, and dehydrator capacity while maintaining the alfalfa quality and leaf quantity. The windrowed alfalfa is then chopped and hauled to the dehydration facility. The truck dumps the chopped alfalfa (wet chops) onto a self-feeding conveyor assembly that feeds a direct-fired rotary drum. Within the drum, the wet chops are dried from an initial moisture content of about 30 to 70 percent (by weight, wet basis) to about 6 to 12 percent. Typical combustion gas temperatures within the gas-fired drum range from 154° to 816°C (300° to 1500°F) at the inlet to 60° to 95°C (140° to 210°F) at the outlet. A fan located at the dryer discharge pneumatically conveys the dried material to the primary cyclone that separates the gases and steam from the dried material and releases them to the atmosphere.

Material collected by the primary cyclone is discharged through the exit duct to a hammer-mill, which grinds the dry chops into meal. A blower at the hammer-mill discharge picks up the screened, relatively fine powder and delivers it either to an additional and similar secondary grinding operation or to a meal collector cyclone, in which the meal is separated from the airstream and discharged into a holding bin. The exhaust is recycled to a bag filter (baghouse). The meal is conveyed to a pellet mill. The extruded pellets are conveyed directly to bagging, bulk storage, or bulk shipping facilities.

2.2.2 Alfalfa Pellet Production

In the pelletizing operation, alfalfa meal is fed into a pellet mill where it is steam conditioned and extruded into pellets. From the pellet mill, the pellets are either pneumatically or mechanically conveyed to a cooler, through which air is drawn to cool the pellets and, in some cases, remove fines. Fines are more commonly removed using shaker screens located before or after the cooler, with the fines being conveyed back into the meal collector cyclone, meal bin, or pellet mill. Cyclone separators may be employed to separate entrained fines in the cooler exhaust and to collect pellets when the pellets are pneumatically conveyed from the pellet mill to the cooler.

Following cooling and screening, the pellets are transferred to bulk storage. Dehydrated alfalfa is most often stored and shipped in pellet form, although the pellets may also be ground in a hammermill and shipped in meal form. When the finished or ground pellets are pneumatically or mechanically transferred to storage or loadout, additional cyclones may be used for product airstream separation.

In addition, some of the larger mills formulate feeds from meal pellets to meet customer and market demands. The pelletized material is reduced to meal by hammer-mill grinding and then pneumatically conveyed to an air separator cyclone. Next, it is piped to a blender for formulation and then travels to bagging equipment or bulk shipping facilities.

There are variations of the process described above depending on the desired nature of the product, the physical layout of the plant, and the modifications made for air pollution control. Common variations include recirculating the exhaust gas stream from one or more of the downstream cyclones back through the primary cyclone and recirculating a portion of the primary cyclone exhaust back into the furnace. Another modification involves recirculating a part of the meal collector cyclone exhaust back into the hammermill, with the remainder ducted to the primary cyclone or

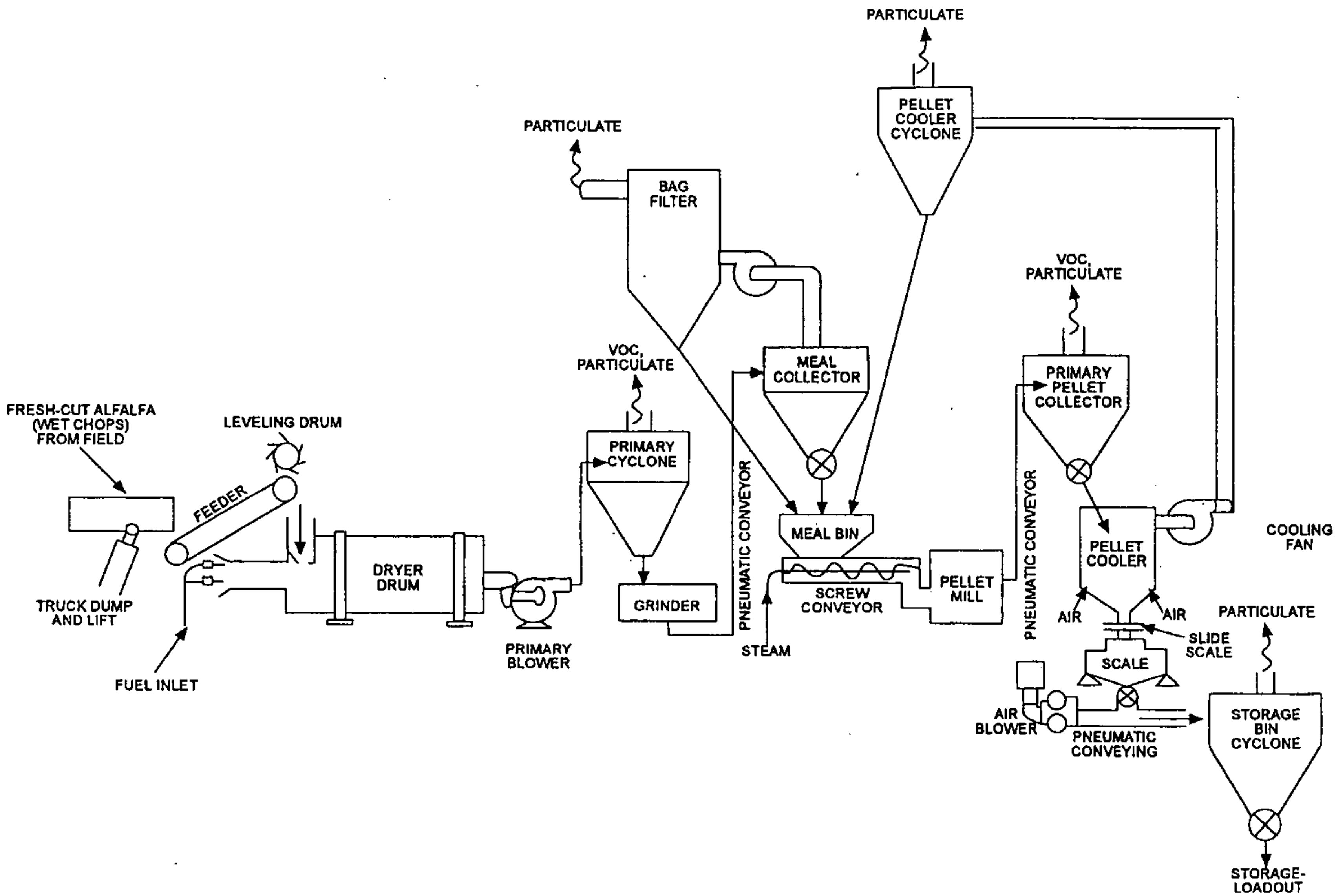

Figure 2-1. Process flow diagram for a typical alfalfa dehydrator.[5]

discharged directly to a bag filter. Also, additional cyclones may be employed if the pellets are pneumatically rather than mechanically conveyed from the pellet mill to the cooler or if the finished pellets or ground pellets are pneumatically conveyed to storage or loadout.

2.3 EMISSIONS[3]

Particulate matter is the primary pollutant emitted from alfalfa dehydrating plants, although some odors may also arise from the organic volatiles driven off during drying and pellet formation. The major source of emissions is the primary cyclone following the dryer drum. Lesser emission sources include the downstream cyclone separators and the bagging and loading operations.

2.4 EMISSION CONTROL TECHNOLOGY[3,6-7]

Air pollution control (and product recovery) is accomplished in alfalfa dehydrating plants in a variety of ways. A simple, yet effective technique is the proper maintenance and operation of the alfalfa dehydrating equipment. Particulate emissions can be reduced significantly if the feeder discharge rates are uniform, if the dryer furnace is operated properly, if proper airflows are employed in the cyclone collectors, and if the hammermill is well maintained and not overloaded. It is especially important in this regard not to overdry and possibly burn the chops as this results in the generation of smoke and increased fines in the grinding and pelletizing operations.

Equipment modification provides another means of particulate control. Existing cyclones can be replaced with more efficient cyclones and concomitant air flow systems. In addition, the furnace and burners can be modified or replaced to minimize flame impingement on the incoming green chops. In plants where the hammermill is a production bottleneck, a tendency exists to overdry the chops to increase throughput, which results in increased emissions. Adequate hammermill capacity can reduce this practice.

Secondary control devices can be employed on the cyclone collector exhaust streams. Generally, this practice has been limited to the installation of secondary cyclones or fabric filters on the meal collector, pellet collector, or pellet cooler cyclones. Careful design incorporating flame-proof baghouse filter media, integral fire extinguisher devices, and alert plant operation are necessary to minimize the possibility of fires. Some measure of secondary control can also be effected on these cyclones by recirculating their exhaust streams back into the primary cyclone. Primary cyclones are not controlled by fabric filters because of the high moisture content in the resulting exhaust stream. Medium energy wet scrubbers are effective in reducing particulate emissions from the primary cyclones, but have been installed at only a few mills.

Some mills employ cyclone effluent recycle systems for particulate control. One system skims off the particulate-laden portion of the primary cyclone exhaust and returns it to the alfalfa dryer. Another system recycles a large portion of the meal collector cyclone exhaust back to the hammermill. Both systems can be effective in controlling particulates but may result in operating problems, such as condensation in the recycle lines and plugging or overheating of the hammermill.

REFERENCES FOR SECTION 2

1. "Air Pollution from Alfalfa Dehydrating Mills," Technical Report A 60-4, Robert A. Taft Sanitary Engineering Center, U.S.P.H.S., Department of Health, Education, and Welfare, Cincinnati, OH.

2. Schafer, R.D., "How Ohio is Solving the Alfalfa Dust Problem," A.M.A. Archives of Industrial Health, Vol. 17, pp. 67-69. January 1958.

3. Source information supplied by Ken Smith of the American Dehydrators Association, Mission, KS. December 1975.

4. Facsimile from W. Cobb, American Alfalfa Processors Association, to T. Campbell, Midwest Research Institute. "USDA Livestock & Grain Market News Service: Alfalfa Meal. May 23, 1995.

5. Written correspondence from W. Cobb, American Alfalfa Processors Association, to T. Campbell, Midwest Research Institute. Updated alfalfa dehydration process diagram. May 18, 1995.

6. Gorman, P. G., et al., Emission Factor Development for the Feed and Grain Industry. Midwest Research Institute, Kansas City, MO. Prepared for U. S. Environmental Protection Agency, Research Triangle Park, NC, under Contract No. 68-02-1324. Publication No. EPA-450/3-75-054. October 1974.

7. Smith, K. D., Particulate Emissions from Alfalfa Dehydrating Plants - Control Costs and Effectiveness. Final Report. American Dehydrators Association. Mission, KS. Prepared for U. S. Environmental Protection Agency, Research Triangle Park, NC. Grant No. R801446. Publication No. 650/2-74-007. January 1974.

3. GENERAL DATA REVIEW AND ANALYSIS PROCEDURES

3.1 LITERATURE SEARCH AND SCREENING

Data for this investigation were obtained from a number of sources within the Office of Air Quality Planning and Standards (OAQPS) and from outside organizations. The AP-42 background files located in the Emission Factors and Inventory Group (EFIG) were reviewed for information on the industry, processes, and emissions. Information on the industry, including number of plants, plant location, and annual production capacities, was obtained from the *Census of Manufactures*, and other sources. In addition, representative trade associations, including the American Alfalfa Processors Association, were contacted for assistance in obtaining information about the industry and emissions. Updated process descriptions and new emissions tests supplied by the trade associations were reviewed and included in this revision.

To screen out unusable test reports, documents, and information from which emission factors could not be developed, the following general criteria were used:

1. Emission data must be from 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. For example, a technical paper was not included if the original study was contained in the previous document. If the exact source of the data could not be determined, the document was eliminated.

2. The referenced study should contain test results based on more than one test run. If results from only one run are presented, the emission factors must be down rated.

3. The report must contain sufficient data to evaluate the testing procedures and source operating conditions (e.g., one-page reports were generally rejected).

A final set of reference materials was compiled after a thorough review of the pertinent reports, documents, and information according to these criteria.

3.2 DATA QUALITY RATING SYSTEM[1]

As part of the analysis of the emission data, the quantity and quality of the information contained in the final set of reference documents were evaluated. The following data were excluded from consideration:

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

2. Test series representing incompatible test methods (i.e., comparison of EPA Method 5 front half with EPA Method 5 front and back half);

3. Test series of controlled emissions for which the control device is not specified;

4. Test series in which the source process is not clearly identified and described; and

5. Test series in which it is not clear whether the emissions were measured before or after the control device.

Test data sets that were not excluded were assigned a quality rating. The rating system used was that specified by EFIG for preparing AP-42 sections. The data were rated as follows:

A—Multiple tests that were performed on the same source using sound methodology and reported in enough detail for adequate validation. These tests do not necessarily conform to the methodology specified in EPA reference test methods, although these methods were used as a guide for the methodology actually used.

B—Tests that were performed by a generally sound methodology but lack enough detail for adequate validation.

C—Tests that were based on an untested or new methodology or that lacked a significant amount of background data.

D—Tests that were based on a generally unacceptable method but may provide an order-of-magnitude value for the source.

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

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

2. Sampling procedures. The sampling procedures conformed to a generally acceptable methodology. If actual procedures deviated from accepted methods, the deviations are well documented. When this occurred, an evaluation was made of the extent to which such alternative procedures could influence the test results.

3. Sampling and process data. Adequate sampling and process data are documented in the report, and any variations in the sampling and process operation are noted. 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 contain original raw data sheets. The nomenclature and equations used were compared to those (if any) specified by EPA to establish equivalency. The depth of review of the calculations was dictated by the reviewer's confidence in the ability and conscientiousness of the tester, which in turn was 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 quality of the emission factors developed from analysis of the test data was rated using the following general criteria:

A—Excellent: Developed only from A- and B-rated test data taken from many randomly chosen facilities in the industry population. The source category is specific enough so that variability within the source category population may be minimized.

B—Above average: Developed only from A- and B-rated test data from a reasonable number of facilities. Although no specific bias is evident, it is not clear if the facilities tested represent a random sample of the industries. The source category is specific enough so that variability within the source category population may be minimized.

C—Average: Developed only from A-, B-, and/or C-rated test data from a reasonable number of facilities. Although no specific bias is evident, it is not clear if the facilities tested represent a random sample of the industry. In addition, the source category is specific enough so that variability within the source category population may be minimized.

D—Below average: The emission factor was developed only from A, B, and/or C-rated test data from a small number of facilities, and there is reason to suspect that these facilities do 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 noted in the emission factor table.

E—Poor: The emission factor was developed from C- and D-rated test data, and there is reason to suspect that the facilities tested do 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 these criteria is somewhat subjective and depends to an extent upon the individual reviewer. Details of the rating of each candidate emission factor are provided in Section 4.

REFERENCE FOR SECTION 3

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

4. REVIEW OF SPECIFIC DATA SETS

This section describes the references and test data that were evaluated and the methodology used to revise the existing AP-42 section for alfalfa dehydration. The test data used in the existing AP-42, Section 6.1 (Fourth Edition), are briefly described in this section but are not used to develop emission factors.

4.1 REVIEW OF SPECIFIC DATA SETS[1-12]

References 1 through 3 were presented in AP-42 Section 6.1 (Fourth Edition) and are described briefly in this section. They are not used to develop candidate emission factors for AP-42 Section 9.9.4, Alfalfa Dehydration, because of the significant process changes described in reference 4. References 5 through 11 are discusssed in this section and are used to develop candidate emission factors for the alfalfa dehydration process. Reference 12 provides production rates for references 5 through 8.

4.1.1 Reference 1

This reference provided the results of the industry's 1974 and 1975 compliance tests. In 1974, test results are reported for 19 plants and for 1975, results are reported for 10 plants. Average emission factors are reported for a combination of one or more control devices; factors are not separated by device. The average emission factor for the 1974 tests was about 10 lb per ton of pellets produced. For 1975, the average emission factor for the 10 plants was 7.1 lb per ton of pellets produced. Except for two plants, the plants tested in 1975 were different from those tested in 1974. No information was provided for the test procedures or methods and no test reports were provided. Because no test procedures were given and the results are for processes no longer used at the plants, these factors were not used.

4.1.2 Reference 2

This 1974 reference is an evaluation of data used to develop emission factors for alfalfa dehydration plants, grain elevators, and other feed and grain operations. All data in this report are secondary data based on other summary reports. The factors were developed for processes that are no longer used by this industry or have been significantly modified since this report was issued. The factors in this report were not considered appropriate for inclusion in this section.

4.1.3 Reference 3

This 1974 report presents the results of a testing program to characterize particulate emissions from alfalfa dehydrating plants and to evaluate the cost and effectiveness of available control methods. Testing was conducted during the growing seasons of 1971, 1972, and 1973 at 14 plants in Kansas, Nebraska, and Colorado. All data presented were summary results based on the tests. No test procedures or actual field data were presented. The factors in this report are not representative of current industry practices and are not used in this section.

4.1.4 Reference 4

This reference is a memorandum identifying the changes in the alfalfa dehydration process that have occurred since the AP-42 section presented in the 4th edition was developed in 1976.

4.1.5 Reference 5

This reference is a stack test conducted at the Gothenburg Feed Products alfalfa dehydrating plant in Gothenburg, Nebraska in 1993. The alfalfa dehydration plant consisted of a natural gas-fired, triple-pass dryer. The control equipment used at the site was a cyclone. Tests were conducted in the primary cyclone stack. The EPA Methods 1 through 4 were used for the determination of traverse point locations, velocities, and flows of stack gas, oxygen, carbon dioxide, and moisture. Sampling and analysis for filterable and condensible particulate were performed according to EPA Method 5. The results of the stack tests are presented in Appendix A. The conditions were the same for each test run. Although this source test used sound methodology and was reported in adequate detail, the test data was B-rated because only two of the three test runs could be used to calculate emissions (one test run was not used due to a low isokinetic percentage).

The actual production rate during the test runs was 4.36 tons of pellets per hour. Averaging the total (filterable plus condensible) particulate emissions for test runs 2 and 3 gives an emission factor of 6.6 pounds (lb) of particulate per ton of pellets produced. Test Run No.1 was not used in emission factor calculations because of a low isokinetic percentage.

4.1.6 Reference 6

This reference is a stack test conducted at the Shofstall alfalfa dehydrating plant in Odessa, Nebraska in 1993. The alfalfa dehydration plant consisted of a natural gas-fired, triple-pass dryer. The control equipment used at the site was a cyclone. Tests were conducted in the primary cyclone stack. The EPA Methods 1 through 4 were used for the determination of traverse point locations, velocities, and flows of stack gas, oxygen, carbon dioxide, and moisture. The filterable and condensible particulate sampling and analysis were performed according to EPA Method 5. The results of the stack tests are presented in Appendix B. The conditions were the same for each test run. This source test was A-rated.

The actual production rate during the test runs was 8 tons of pellets per hour. Averaging the total particulate emissions for test runs 1 through 3 gives an emission factor of 4.9 lb of particulate per ton of pellets produced.

4.1.7 Reference 7

This reference is a stack test conducted at the Morrison and Quirk alfalfa dehydrating plant in Lyons, Nebraska in 1993. The alfalfa dehydration plant consisted of a natural gas-fired, single-pass dryer. The control equipment used following the dryer was a cyclone. Tests were conducted in the primary cyclone stack. The EPA Methods 1 through 4 were used for the determination of traverse point locations, velocities, and flows of stack gas, oxygen, carbon dioxide, and moisture. The filterable and condensible particulate sampling and analysis were performed according to EPA Method 17. The results of the stack tests are presented in Appendix C. The conditions were the same for each test run. This source test was A-rated.

The actual production rate during the test runs averaged 5.2 tons of pellets per hour. Averaging the total particulate emissions for test runs 1 through 3 gives an emission factor of 1.2 lb of particulate per ton of pellets produced.

It is noted that the total and filterable PM data for this test are considerably lower than the corresponding PM data in references 5 and 6, which used EPA Method 5 instead of Method 17. No rationale was provided in the test report for the use of Method 17.

4.1.8 Reference 8

This reference is stack test conducted at the Lexington Alfalfa Dehydrators plant in Darr, Nebraska in 1993. The alfalfa dehydration plant operated a natural gas-fired, single-pass dryer. The control device in operation at the time of testing was a cyclone. Tests were conducted in the primary cyclone stack. The EPA Methods 1 through 4 were used for the determination of traverse point locations, velocities, and flows of stack gas, oxygen, carbon dioxide, and moisture. The particulate sampling and analysis of the samples were performed according to EPA Method 17. The results of the stack tests are presented in Appendix D. The conditions were the same for each test run. This source test was A-rated.

The actual production rate during the test runs was 5 tons of pellets per hour. Averaging the total particulate emissions for test runs 1 through 3 gives an emission factor of 8.3 lb of particulate per ton of pellets produced.

4.1.9 Reference 9

This report documents a compliance test conducted at the Verhoff Alfalfa Mills facility in Hoytville, Ohio, on September 18, 1992. The wood-fired, single-pass alfalfa dryer followed by a cyclone was tested in the cyclone stack for filterable PM and condensible PM emissions. Particulate matter emissions were quantified using EPA Method 5 (including front- and back-half analyses). Three valid test runs were conducted. The quantity of finished pellets produced during each test run were included in the report. The average total PM emission factor was 6.4 lb per ton of finished pellet produced.

The data from this report are assigned an A rating. The test methodology appears to be sound, sufficient process data are provided, and adequate detail is included in the report. Pertinent test data, process data, and emission factor calculations are provided in Appendix E.

4.1.10 Reference 10

This report documents a compliance test conducted at the Toledo Alfalfa Mills facility in Oregon, Ohio, on May 26, 1987. The coal-fired, triple-pass alfalfa dryer followed by a cyclone was tested in the cyclone stack for filterable PM emissions; no condensible PM levels were reported. Particulate matter emissions were quantified using EPA Method 5 (front-half analysis only). Three valid test runs were conducted. The quantity of finished pellets produced during each run were not reported; the PM emissions were based on the quantity of dried alfalfa to the hammermill. The average filterable PM emission factor was 7.5 lb per ton of dried alfalfa.

The data from this report are assigned a C rating. The test method appears to be sound and adequate detail is included in the report. Data for the quantity of finished pellets produced were not included in the report and are not available. Pertinent test data, process data, and emission factor calculations are provided in Appendix F.

4.1.11 Reference 11

This report documents a compliance test conducted at the Verhoff Alfalfa Mills facility in Ottawa, Ohio, on June 22, 1992. The wood-fired, single-pass alfalfa dryer followed by a cyclone was tested in the cyclone exhaust stack for filterable PM and condensible PM. Particulate matter emissions were quantified using EPA Method 5 (including front- and back-half analyses). Three valid test runs were conducted. The quantity of finished pellets produced during each test run were included in the report. The average total PM emission factor was 2.4 lb per ton of finished pellet produced.

The data from this report are assigned an A rating. The methodology appears to be sound, sufficient process data are provided, and adequate detail is included in the report. Pertinent test data, process data, and emission factor calculations are provided in Appendix G.

A summary of references 5 through 11 is shown in Table 4-1. Full citations for these references are given at the end of this section. Pertinent excerpts from these references are provided in the Appendices A through G.

4.2 DEVELOPMENT OF CANDIDATE EMISSION FACTORS[4-12]

Candidate emission factors were developed by using references 5 through 12 and are discussed below. References 1 through 3 were not used to develop emission factors due to significant changes in the alfalfa dehydration process since references 1 through 3 were published (see reference 4).

Candidate emission factors shown in Table 4-2 were developed for two single-pass dryer cyclones and two triple-pass dryer cyclones. The candidate emission factors for the single-pass dryer cyclone were based on four source tests. The candidate emission factors for the triple-pass dryer cyclone were developed from three source tests. These emission factors are D-rated because of the small number of facilities tested. No data were available for VOC emissions from any source or for particulate emissions from the meal collector bag filter, pellet cooler cyclone, pellet collector, or storage bin cyclone.

4.3 SUMMARY OF CHANGES TO AP-42 SECTION

4.3.1 Section Narrative

The section narrative was revised to include a more detailed process description and discussion of emissions and controls. A process flow diagram for a typical alfalfa dehydration facility was also updated.

TABLE 4-1. SUMMARY OF EMISSION TEST DATA FOR ALFALFA DEHYDRATION

Source	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)[a]	Average emission factor, kg/Mg (lb/ton)	Ref. No.
Gas-fired, triple-pass dryer cyclone	Filterable PM	2	B	1.5-3.3 (3.1-6.5)	2.4 (4.8)	5
	Condensible PM	2	B	0.12-1.7 (0.25-3.4)	0.91 (1.8)	5
Gas-fired, triple-pass dryer cyclone	Filterable PM	3	A	1.9-2.9 (3.7-5.8)	2.3 (4.7)	6
	Condensible PM	3	A	0.08-0.09 (0.15-0.18)	0.08 (0.17)	6
Gas-fired, single-pass dryer cyclone	Filterable PM	3	A	0.38-0.63 (0.76-1.3)	0.50 (0.99)	7
	Condensible PM	3	A	0.07-0.17 (0.13-0.34)	0.11 (0.22)	7
Gas-fired, single-pass dryer cyclone	Filterable PM	3	A	2.5-5.8 (4.9-11.5)	3.6 (7.2)	8
	Condensible PM	3	A	0.14-1.3 (0.28-2.6)	0.54 (1.1)	8
Wood-fired, single-pass dryer cyclone	Filterable PM	3	A	1.6-2.2 (3.2-4.5)	1.9 (3.8)	9
	Condensible PM	3	A	0.8-1.5 (1.6-3.0)	1.3 (2.5)	9
Coal-fired, triple-pass dryer cyclone	Filterable PM	3	C	3.3-4.1 (6.5-8.1)[b]	3.8 (7.5)[b]	10
Wood-fired, single-pass dryer cyclone	Filterable PM	3	A	1.0-1.3 (2.1-2.6)	1.2 (2.3)	11
	Condensible PM	3	A	0.03-0.05 (0.07-0.1)	0.04 (0.09)	11

[a]Emission factors are calculated using the emission rate in the cited reference and the production rate during the test period.
[b]Emission factor based on tons of dried alfalfa to the hammermill.

TABLE 4-2. SUMMARY OF PARTICULATE EMISSION FACTORS FOR ALFALFA DEHYDRATION[a]

Source	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)	Average emission factor, kg/Mg (lb/ton)	Ref. No.
Gas-fired, triple-pass dryer cyclone	Filterable PM	5	D	1.5-3.3 (3.0-6.5)	2.4 (4.8)	5,6
	Condensible PM	5	D	0.08-1.7 (0.15-3.4)	0.50 (1.0)	5,6
Coal-fired, triple-pass dryer cyclone	Filterable PM	3	D	3.3-4.1 (6.5-8.1)[b]	3.8 (7.5)[b]	10
Gas-fired, single-pass dryer cyclone	Filterable PM	6	D	0.38-5.8 (0.76-11.5)	2.1 (4.1)	7,8
	Condensible PM	6	D	0.07-1.3 (0.13-2.6)	0.33 (0.65)	7,8
Wood-fired, single-pass dryer cyclone	Filterable PM	6	D	1.0-2.2 (2.1-4.5)	1.6 (3.1)	9,11
	Condensible PM	6	D	0.03-1.5 (0.07-3.0)	0.7 (1.3)	9,11

[a]Emission factor units are kg (lb) of pollutant per Mg (ton) of finished pellets produced, unless noted.
[b]Emission factor based on quantity of dried alfalfa to the hammermill.

4.3.2 Emission Factors

The emission factor table for the AP-42 section was revised based on the emission factors developed from new test data. Previous emission factors were based on source tests conducted in the 1970's and were not used because of major changes in the alfalfa dehydration process.

REFERENCES FOR SECTION 4

1. Source information supplied by Ken Smith of the American Dehydrators Association, Mission, KS. December 1975.

2. Gorman, P.G. et al. Emission Factor Development for the Feed and Grain Industry. Midwest Research Institute. Kansas City, MO. Prepared for U. S. Environmental Protection Agency, Research Triangle Park, NC under Contract No. 68-02-1324. Publication No. EPA-450/3-75-054. October 1974.

3. Smith, K.D. Particulate Emissions from Alfalfa Dehydrating Plants - Control Costs and Effectiveness. Final Report. American Dehydrators Association. Mission, KS. Prepared for U. S. Environmental Protection Agency, Research Triangle Park, NC. Grant No. R801446. Publication No. 650/2-74-007. January 1974.

4. Telephone conversation between D. Burkholder, Shofstall Alfalfa, and T. Lapp and T. Campbell, Midwest Research Institute. Clarification of alfalfa dehydration process. June 13, 1995.

5. Source Emissions Report for Gothenburg Feed Products Co., Gothenburg, NE. Prepared by AirSource Technologies, Lenexa, KS. October 8, 1993.

6. Source Emissions Report for Shofstall Alfalfa, Alfalfa Dehydrating Facility, Odessa, NE. Prepared by AirSource Technologies, Lenexa, KS. October 15, 1993.

7. Source Emissions Report for Morrison & Quirk, Inc., Alfalfa Dehydrating Facility, Lyons, NE. Prepared by AirSource Technologies, Lenexa, KS. October 15, 1993.

8. Source Emissions Report for Lexington Alfalfa Dehydrators, Inc., Alfalfa Dehydrating Facility, Darr, NE. Prepared by AirSource Technologies, Lenexa, KS. October 15, 1993.

9. Stack Particulate Samples Collected at Verhoff Alfalfa, Hoytville, OH. Submitted by Affiliated Environmental Services, Inc., Sandusky, OH. September 25, 1992.

10. Emission Test Report for Toledo Alfalfa, Oregon, OH. Prepared by Owens-Illinois Analytical Services, Toledo, OH. June 4, 1987.

11. Stack Particulate Samples Collected at Verhoff Alfalfa, Ottawa, OH. Submitted by Affiliated Environmental Services, Inc., Sandusky, OH. June 28, 1995.

12. Facsimile from W. Cobb, American Alfalfa Processors Association, to T. Campbell, Midwest Research Institute. Production rates for emission test reports. February 21, 1995.

5. PROPOSED AP-42 SECTION

The proposed AP-42, Section 9.9.4, Alfalfa Dehydration, is presented on the following pages as it would appear in the document.

9.9.4 Alfalfa Dehydrating

9.9.4.1 General[1-2]

Dehydrated alfalfa is a meal product resulting from the rapid drying of alfalfa by artificial means. Alfalfa meal is processed into pellets for use in chicken rations, cattle feed, hog rations, sheep feed, turkey mash, and other formula feeds. It is important for its protein content, growth and reproductive factors, pigmenting xanthophylls, and vitamin contributions.

9.9.4.2 Process Description[1-5]

A schematic of a generalized alfalfa dehydrator plant is given in Figure 9.9.4-1. Standing alfalfa is windrowed in the field to allow wilting to reduce moisture to an acceptable level balancing energy requirements, trucking requirements, and dehydrator capacity while maintaining the alfalfa quality and leaf quantity. The windrowed alfalfa is then chopped and hauled to the dehydration plant. The truck dumps the chopped alfalfa (wet chops) onto a self-feeder, which carries it into a direct-fired rotary drum. Within the drum, the wet chops are dried from an initial moisture content of about 30 to 70 percent (by weight, wet basis) to about 6 to 12 percent. Typical combustion gas temperatures within the gas-fired drum range from 154° to 816°C (300° to 1500°F) at the inlet to 60° to 95°C (140° to 210°F) at the outlet.

From the drying drum, the dry chops are pneumatically conveyed into a primary cyclone that separates them from the high-moisture, high-temperature exhaust stream. From the primary cyclone, the chops are fed into a hammermill, which grinds the dry chops into a meal. The meal is pneumatically conveyed from the hammermill into a meal collector cyclone in which the meal is separated from the airstream and discharged into a holding bin. The exhaust is recycled to a bag filter (baghouse). The meal is then fed into a pellet mill where it is steam conditioned and extruded into pellets.

From the pellet mill, the pellets are either pneumatically or mechanically conveyed to a cooler, through which air is drawn to cool the pellets and, in some cases, remove fines. Fines are more commonly removed using shaker screens located ahead of or following the cooler, with the fines being conveyed back into the meal collector cyclone, meal bin, or pellet mill. Cyclone separators may be employed to separate entrained fines in the cooler exhaust and to collect pellets when the pellets are pneumatically conveyed from the pellet mill to the cooler.

Following cooling and screening, the pellets are transferred to bulk storage. Dehydrated alfalfa is most often stored and shipped in pellet form, although the pellets may also be ground in a hammermill and shipped in meal form. When the finished or ground pellets are pneumatically or mechanically transferred to storage or loadout, additional cyclones may be used for product airstream separation.

9.9.4.3 Emissions And Controls[1-3,5-7]

Particulate matter (PM) is the primary pollutant emitted from alfalfa dehydrating plants, although some odors may arise from the organic volatiles driven off during drying and pellet formation. The major source of PM emissions is the primary cyclone following the dryer drum.

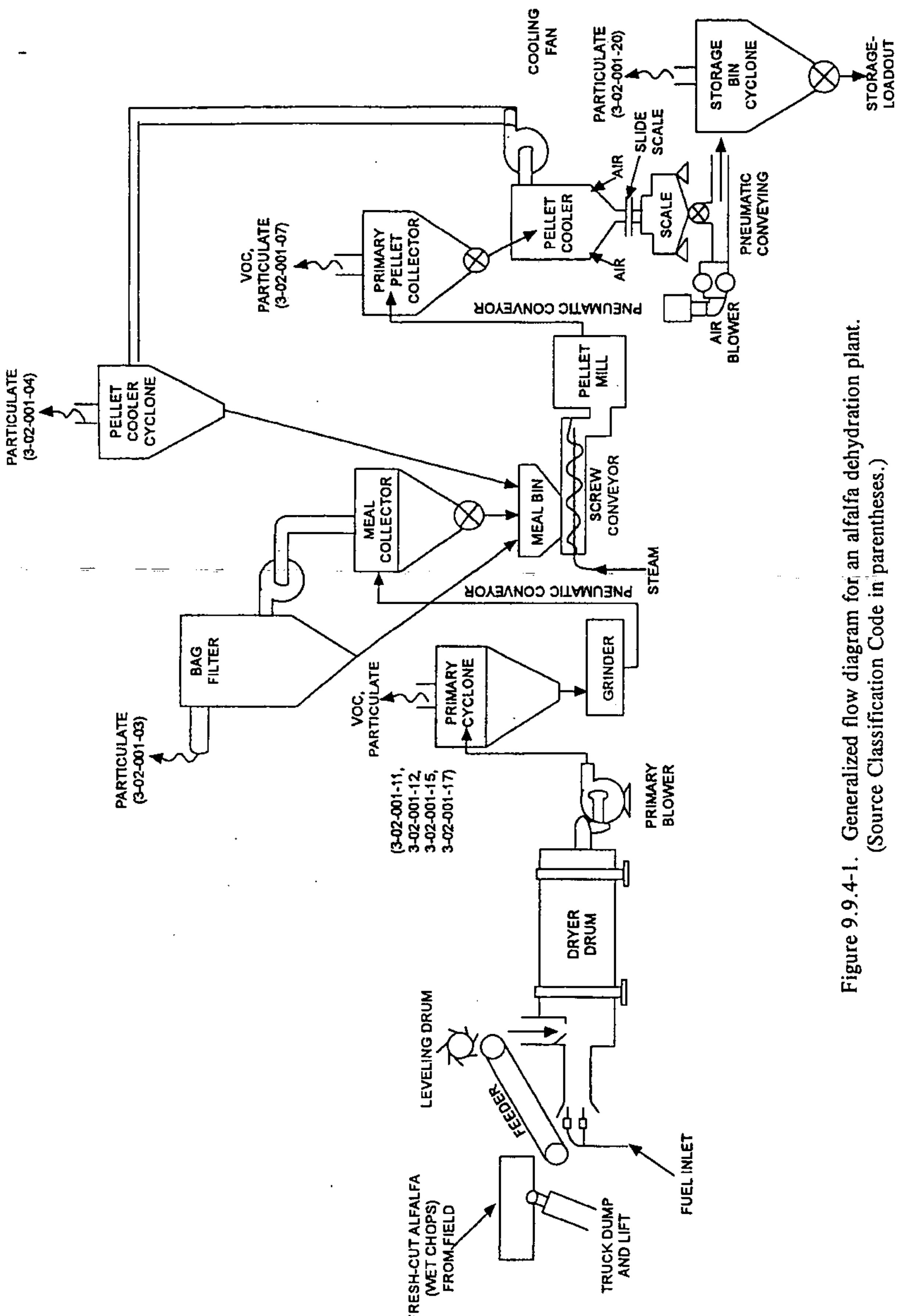

Figure 9.9.4-1. Generalized flow diagram for an alfalfa dehydration plant.
(Source Classification Code in parentheses.)

Lesser emission sources include the downstream cyclone separators and the bagging and loading operations.

Emission factors for various dryer types utilized in alfalfa dehydrating plants are given in Table 9.9.4-1. Note that, although these sources are common to many plants, there will be considerable variation from the generalized flow diagram in Figure 9.9.4-1 depending on the desired nature of the product, the physical layout of the plant, and the modifications made for air pollution control.

Table 9.9.4-1. EMISSION FACTORS FOR ALFALFA DEHYDRATION[a]

EMISSION FACTOR RATING: D

	Particulate (PM)			
Source	Filterable	Condensible	VOC	Ref.
Triple-pass dryer cyclone				
- Gas-fired (SCC 3-02-001-11)	4.8	1.0	ND	8-9
- Coal-fired[b] (SCC 3-02-001-12)	7.5	ND	ND	13
Single-pass dryer cyclone				
- Gas-fired (SCC 3-02-001-15)	4.1	0.65	ND	10-11
- Wood-fired (SCC 3-02-001-17)	3.1	1.3	ND	12,14
Meal collector cyclone (SCC 3-02-001-03)	ND	ND	NA	
- Bag filter				
Pellet collector cyclone (SCC 3-02-001-07)	ND	ND	ND	
Pellet cooler cyclone (SCC 3-02-001-04)	ND	ND	NA	
Storage bin cyclone (SCC 3-02-001-20)	ND	ND	NA	

[a] Emission factor units are lb/ton of finished pellet produced, unless noted. To convert from lb/ton to kg/Mg, multiply by 0.5. SCC = Source Classification Code. ND = No data. NA = Not applicable.
[b] Emission factor based on quantity of dried alfalfa to hammermill.

Air pollution control (and product recovery) is accomplished in alfalfa dehydrating plants in a variety of ways. A simple, yet effective technique is the proper maintenance and operation of the alfalfa dehydrating equipment. Particulate emissions can be reduced significantly if the feeder discharge rates are uniform, if the dryer furnace is operated properly, if proper airflows are employed in the cyclone collectors, and if the hammermill is well maintained and not overloaded. It is especially important in this regard not to overdry and possibly burn the chops as this results in the generation of smoke and increased fines in the grinding and pelletizing operations.

Equipment modification provides another means of particulate control. Existing cyclones can be replaced with more efficient cyclones and concomitant air flow systems. In addition, the furnace and burners can be modified or replaced to minimize flame impingement on the incoming green chops. In plants where the hammermill is a production bottleneck, a tendency exists to overdry the chops to increase throughput, which results in increased emissions. Adequate hammermill capacity can reduce this practice. Recent improvements in process technique and emission control technology have reduced particulate emissions from dehydration facilities. Future technology should contribute to further reductions in particulate emissions.

Secondary control devices can be employed on the cyclone collector exhaust streams. Generally, this practice has been limited to the installation of secondary cyclones or fabric filters on the meal collector, pellet collector or pellet cooler cyclones. Primary cyclones are not controlled by fabric filters because of the high moisture content in the resulting exhaust stream. Medium energy wet scrubbers are effective in reducing particulate emissions from the primary cyclones, but have only been installed at a few plants.

Some plants employ cyclone effluent recycle systems for particulate control. One system skims off the particulate-laden portion of the primary cyclone exhaust and returns it to the alfalfa dryer. Another system recycles a large portion of the meal collector cyclone exhaust back to the hammermill. Both systems can be effective in controlling particulates but may result in operating problems, such as condensation in the recycle lines and plugging or overheating of the hammermill.

References For Section 9.9.4

1. *Air Pollution From Alfalfa Dehydrating Mills*, Technical Report A 60-4, Robert A. Taft Sanitary Engineering Center, U.S.P.H.S., Department Of Health, Education, And Welfare, Cincinnati, OH.

2. Schafer, R.D., "How Ohio Is Solving The Alfalfa Dust Problem", *A.M.A. Archives Of Industrial Health*, *17*:67-69, January 1958.

3. Source information supplied by Ken Smith of the American Dehydrators Association, Mission, KS, December 1975.

4. Written correspondence from W. Cobb, American Alfalfa Processors Association, to T. Campbell, Midwest Research Institute, Updated alfalfa dehydration process diagram, May 18, 1995.

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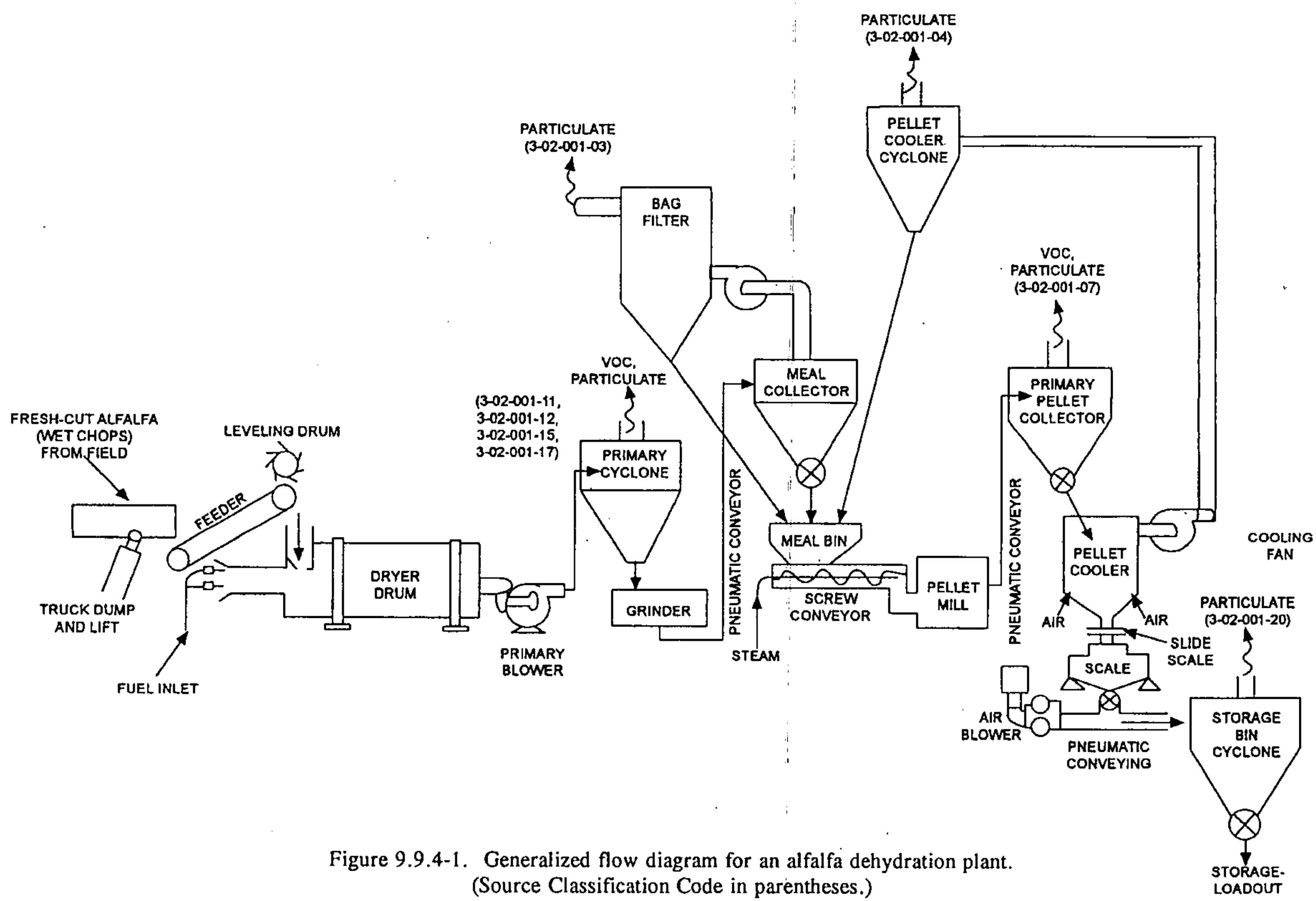

Figure 9.9.4-1. Generalized flow diagram for an alfalfa dehydration plant. (Source Classification Code in parentheses.)

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- Coal-fired[b] (SCC 3-02-001-12)	7.5	ND	ND	13
Single-pass dryer cyclone				
- Gas-fired (SCC 3-02-001-15)	4.1	0.65	ND	10-11
- Wood-fired (SCC 3-02-001-17)	3.1	1.3	ND	12,14
Meal collector cyclone (SCC 3-02-001-03)	ND	ND	NA	
- Bag filter				
Pellet collector cyclone (SCC 3-02-001-07)	ND	ND	ND	
Pellet cooler cyclone (SCC 3-02-001-04)	ND	ND	NA	
Storage bin cyclone (SCC 3-02-001-20)	ND	ND	NA	

[a] Emission factor units are lb/ton of finished pellet produced, unless noted. To convert from lb/ton to kg/Mg, multiply by 0.5. SCC = Source Classification Code. ND = No data. NA = Not applicable.
[b] Emission factor based on quantity of dried alfalfa to hammermill.

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References For Section 9.9.4

1. *Air Pollution From Alfalfa Dehydrating Mills*, Technical Report A 60-4, Robert A. Taft Sanitary Engineering Center, U.S.P.H.S., Department Of Health, Education, And Welfare, Cincinnati, OH.

2. Schafer, R.D., "How Ohio Is Solving The Alfalfa Dust Problem", *A.M.A. Archives Of Industrial Health*, *17*:67-69, January 1958.

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5. Telephone conversation with D. Burkholder, Shofstall Alfalfa, and T. Lapp and T. Campbell, Midwest Research Institute, Clarification of alfalfa dehydration process, June 13, 1995.

6. *Emission Factor Development For The Feed And Grain Industry*, EPA-450/3-75-054, U. S. Environmental Protection Agency, Research Triangle Park, NC, October 1974.

7. *Particulate Emissions From Alfalfa Dehydrating Plants - Control Costs And Effectiveness*, EPA 650/2-74-007, U. S. Environmental Protection Agency, Research Triangle Park, NC, January 1974.

8. *Source Emissions Report For Gothenburg Feed Products Co., Gothenburg, NE*, AirSource Technologies, Lenexa, KS, October 8, 1993.

9. *Source Emissions Report For Shofstall Alfalfa, Alfalfa Dehydrating Facility, Odessa, NE*, AirSource Technologies, Lenexa, KS, October 15, 1993.

10. *Source Emissions Report For Morrison & Quirk, Inc., Alfalfa Dehydrating Facility, Lyons, NE*, AirSource Technologies, Lenexa, KS, October 15, 1993.

11. *Source Emissions Report For Lexington Alfalfa Dehydrators, Inc., Alfalfa Dehydrating Facility, Darr, NE*, AirSource Technologies, Lenexa, KS, October 15, 1993.

12. *Stack Particulate Samples Collected At Verhoff Alfalfa, Hoytville, OH*, Affiliated Environmental Services, Inc., Sandusky, OH, September 25, 1992.

13. *Emission Test Report For Toledo Alfalfa, Oregon, OH*, Owens-Illinois Analytical Services, Toledo, OH, June 4, 1987.

14. *Stack Particulate Samples Collected At Verhoff Alfalfa, Ottawa, OH*, Affiliated Environmental Services, Inc., Sandusky, OH, June 28, 1995.

APPENDIX A

EXCERPTS FROM REFERENCE 5

(Gothenburg Feed Products Company, August 31, 1993)

SOURCE EMISSIONS REPORT
for
GOTHENBURG FEED PRODUCTS CO.
Gothenburg, Nebraska

prepared by
AirSource Technologies

11635 W. 83rd Terrace
Lenexa, Kansas 66214

AirSource Project No. 411922

PREFACE

This report was prepared by AirSource Technologies in response to a test that was conducted at the Gothenburg Feed Products Co. in Gothenburg, Nebraska on August 31, 1993. Any questions concerning this report should be directed to Mr. Blane Wood, Project Manager, or to Mr. George Cobb, General Manager.

AirSource Technologies

Blane Wood

Blane Wood
Project Manager

Approved

George R. Cobb

George R. Cobb
General Manager

Date: October 8, 1993

SECTION 2

SUMMARY OF RESULTS

The results of the particulate emissions are: 15.62 lb.hr, 28.46 lb/hr, and 13.2 lb/hr for Runs 1, 2 and 3 respectively.

Run 1 did not meet the ± 10% of 100% isokinetic criteria. For the purposes of this study, the data should still give an indication of particulate loading. The results are biased low.

The sampling and particulate results are shown in Table 1.

Table 1
SUMMARY OF SAMPLING AND PARTICULATE RESULTS
Gothenburg Feed Products Co.
Gothenburg, Nebraska

Parameters	Unit of Measure	Run 1	Run 2	Run 3
Particulate Emissions				
Front Half	gr/dscf	0.0746	0.1440	0.0624
Uncorrected	gr/dscf	0.3480	0.6719	0.2494
Corrected to 7% O_2	gr/dscf	0.5965	1.1518	0.4989
Emission Rate	lb/hr	15.62	28.46	13.28
Weight	grams	0.1883	0.3865	0.1828
Isokinetics	%	81.9	92.3	93.5
Stack Flow Rate				
Actual	acfm	38,559	39,350	38,248
Standard Conditions	dscfm	24,452	23,066	24,845
Velocity	ft/min.	4,008	4,090	3,975
Sampling Results				
Sampling Volume	dscf	38.891	41.343	45.142
Avg. Stack Temperature	°F	162	183	154
Avg. ΔP	inches H_2O	1.041	1.032	1.039
Avg. ΔH	inches H_2O	1.48	1.69	2.03
Avg. Meter Temperature	°F	63	75	80
Oxygen, Orsat	%	18.0	18.0	17.5
Carbon Dioxide, Orsat	%	1.5	1.5	1.5
Static Pressure	inches H_2O	0.65	0.65	0.65
Moisture Collected	ml	203.5	265.7	221.6
Moisture	% H_2O	19.8	23.2	18.8
Sampling Time	min.	60	60	60

SECTION 3

PROCESS OPERATION

The alfalfa dehydration plant is a 12 foot MEC three pass dryer. The control equipment used is a single compartment baghouse and a 12 foot diameter cyclone. The condition for each of the test runs were the same.

see p. A-11

Table 2 summarizes the results of the process operations and Table 3 presents the process data collected during the testing.

Table 2 SUMMARY OF RESULTS Process Operation	
Historical Average Process Weight (pellets)	12,000 lb/hr
Historical Maximum Process Weight (pellets)	16,000 lb/hr
Type of Fuel Normally Burned	Natural Gas
Approximate Quantity of Fuel Burned Annually	59,500 MCF
Actual Production (pellets)	4.36 TPH
Rated Water Production	25,000 lb/hr
Actual Water Production	9,962 lb/hr
Baghouse - 1 compartment positive pressure	
Type of Cleaning	Reverse Air
Clean Cycle	2 minute
Average baghouse ΔP	3.3 in. H_2O
Fan	
Rated H.P.	25 H.P.
Operating Volts	460 Volts
Operating Amps	18 amps

FILE NAME - GOTHENBURG.R1	PROG.=VER 06/27/89
RUN # - GOTHENBURG RUN 1	09-29-1993 10:52:26
LOCATION - DRYER STACK	
DATE - AUGUST 31, 1993	
PROJECT # - 411922	

Initial Meter Volume (Cubic Feet)=	605.520
Final Meter Volume (Cubic Feet)=	646.069
Meter Factor=	1.019
Final Leak Rate (cu ft/min)=	0.013
Net Meter Volume (Cubic Feet)=	41.319
Gas Volume (Dry Standard Cubic Feet)=	38.891
Barometric Pressure (in Hg)=	27.79
Static Pressure (Inches H20)=	0.65
Percent Oxygen=	18.0
Percent Carbon Dioxide=	1.5
Moisture Collected (ml)=	203.5
Percent Water=	19.8
Average Meter Temperature (F)=	63
Average Delta H (in H20)=	1.48
Average Delta P (in H20)=	1.041
Average Stack Temperature (F)=	162
Dry Molecular Weight=	28.96
Wet Molecular Weight=	26.79
Average Square Root of Delta P (in H20)=	1.~~0191~~
% Isokinetic=	81.9

Out of RANGE — do Not use this RUN!

Pitot Coefficient=	0.84
Sampling Time (Minutes)=	60.0
Nozzle Diameter (Inches)=	0.239
Stack Axis #1 (Inches)=	42.0
Stack Axis #2 (Inches)=	42.0
Circular Stack	
Stack Area (Square Feet)=	9.62
Stack Velocity (Actual, Feet/min)=	4,008
Flow Rate (Actual, Cubic ft/min)=	38,559
Flow rate (Standard, Wet, Cubic ft/min)=	30,478
Flow Rate (Standard, Dry, Cubic ft/min)=	24,452

Particulate Loading - Front Half

		Corr. to 7% O2	& 12% CO2
Particulate Weight (g)=	0.1883		
Particulate Loading, Dry Std. (gr/scf)=	0.0746	0.3480	0.5965
Particulate Loading, Actual (gr/cu ft)=	0.0473		
Emission Rate (lb/hr)=	15.62		

Particulate Loading - Total Catch Including Impingers

Particulate Weight (g)=	0.2506		
Particulate Loading, Dry Std. (gr/scf)=	0.0992	0.4631	0.7939
Particulate Loading, Actual (gr/cu ft)=	0.0629		
Emission Rate (lb/hr)=	20.80		
Percent Impinger Catch=	24.9		

FILE NAME - GOTHENBURG.R2
RUN # - GOTHENBURG.R2
LOCATION - DRYER STACK
DATE - AUGUST 31, 1993
PROJECT # - 411922

PROG.=VER 06/27/89
09-28-1993 16:11:06

Initial Meter Volume (Cubic Feet)=	646.345
Final Meter Volume (Cubic Feet)=	690.385
Meter Factor=	1.019
Final Leak Rate (cu ft/min)=	0.009
Net Meter Volume (Cubic Feet)=	44.877
Gas Volume (Dry Standard Cubic Feet)=	41.343
Barometric Pressure (in Hg)=	27.79
Static Pressure (Inches H20)=	0.65
Percent Oxygen=	18.0
Percent Carbon Dioxide=	1.5
Moisture Collected (ml)=	265.7
Percent Water=	23.2
Average Meter Temperature (F)=	75
Average Delta H (in H20)=	1.69
Average Delta P (in H20)=	1.032
Average Stack Temperature (F)=	183
Dry Molecular Weight=	28.96
Wet Molecular Weight=	26.41
Average Square Root of Delta P (in H20)=	1.0149
% Isokinetic=	92.3
Pitot Coefficient=	0.84
Sampling Time (Minutes)=	60.0
Nozzle Diameter (Inches)=	0.239
Stack Axis #1 (Inches)=	42.0
Stack Axis #2 (Inches)=	42.0
Circular Stack	
Stack Area (Square Feet)=	9.62
Stack Velocity (Actual, Feet/min)=	4,090
Flow Rate (Actual, Cubic ft/min)=	39,350
Flow rate (Standard, Wet, Cubic ft/min)=	30,048
Flow Rate (Standard, Dry, Cubic ft/min)=	23,066

Particulate Loading - Front Half

		Corr. to 7% O2	& 12% CO2
Particulate Weight (g)=	0.3865		
Particulate Loading, Dry Std. (gr/scf)=	0.1440	0.6719	1.1518
Particulate Loading, Actual (gr/cu ft)=	0.0844		
Emission Rate (lb/hr)=	28.46		

Particulate Loading - Total Catch Including Impingers

Particulate Weight (g)=	0.5883		
Particulate Loading, Dry Std. (gr/scf)=	0.2192	1.0227	1.7532
Particulate Loading, Actual (gr/cu ft)=	0.1284		
Emission Rate (lb/hr)=	43.32		
Percent Impinger Catch=	34.3		

FILE NAME - GOTHENBURG.R3
RUN # - GOTHENBURG.R3
LOCATION - DRYER STACK
DATE - AUGUST 31, 1993
PROJECT # - 411922

PROG.=VER 06/27/89
09-28-1993 16:11:44

Initial Meter Volume (Cubic Feet)=	690.543		
Final Meter Volume (Cubic Feet)=	739.070		
Meter Factor=	1.019		
Final Leak Rate (cu ft/min)=	0.005		
Net Meter Volume (Cubic Feet)=	49.449		
Gas Volume (Dry Standard Cubic Feet)=	45.142		
Barometric Pressure (in Hg)=	27.79		
Static Pressure (Inches H20)=	0.65		
Percent Oxygen=	17.5		
Percent Carbon Dioxide=	1.5		
Moisture Collected (ml)=	221.6		
Percent Water=	18.8		
Average Meter Temperature (F)=	80		
Average Delta H (in H20)=	2.03		
Average Delta P (in H20)=	1.039		
Average Stack Temperature (F)=	154		
Dry Molecular Weight=	28.94		
Wet Molecular Weight=	26.89		
Average Square Root of Delta P (in H20)=	1.0186		
% Isokinetic=	93.5		
Pitot Coefficient=	0.84		
Sampling Time (Minutes)=	60.0		
Nozzle Diameter (Inches)=	0.239		
Stack Axis #1 (Inches)=	42.0		
Stack Axis #2 (Inches)=	42.0		
Circular Stack			
Stack Area (Square Feet)=	9.62		
Stack Velocity (Actual, Feet/min)=	3,975		
Flow Rate (Actual, Cubic ft/min)=	38,248		
Flow rate (Standard, Wet, Cubic ft/min)=	30,590		
Flow Rate (Standard, Dry, Cubic ft/min)=	24,845		
Particulate Loading - Front Half			
Particulate Weight (g)=	0.1828	Corr. to 7% O2	& 12% CO2
Particulate Loading, Dry Std. (gr/scf)=	0.0624	0.2494	0.4989
Particulate Loading, Actual (gr/cu ft)=	0.0405		
Emission Rate (lb/hr)=	13.28		
Particulate Loading - Total Catch Including Impingers			
Particulate Weight (g)=	0.1980		
Particulate Loading, Dry Std. (gr/scf)=	0.0675	0.2702	0.5404
Particulate Loading, Actual (gr/cu ft)=	0.0439		
Emission Rate (lb/hr)=	14.38		
Percent Impinger Catch=	7.7		

Filename:
Date:
Facility: Gothenburg Feed Products Co.
Location: Gothenburg, Nebraska
Source: Dryer Cyclone exhaust
Test date: August 31, 1993

Gas- Fired Dryer
Triple-Pass

D. Emission Data/Mass Flux Rates/Emission Factors

Test ID	Parameter	Units	Values reported Run 1	Run 2	Run 3	Run 4	AVERAGE
	Stack temperature	Deg F	162	183	154		
	Pressure	in. HG	27.79	27.79	27.79		
	Moisture	%	19.8	23.2	18.8		
	Oxygen	%	18.0	18.0	17.5		
	Volumetric flow, actual	acfm	38,559	39,350	38,248		
	Volumetric flow, standard*	dscfm	24,452	23,066	24,845		
	Isokinetic variation	%	81.9	92.3	93.5		
Circle: Production or feed rate Capacity: Pellet		TPH		4.36	4.36		
	Pollutant concentrations:						
	Total PM	G/dscf		1.753	0.0675		
	Filterable PM	G/dscf		1.152	0.0624		
	Condensible PM	G/dscf		0.601	0.0051		
	Pollutant mass flux rates:						
	Total PM	lb/hr		43.32	14.38		
	Filterable PM	lb/hr		28.46	13.29		
	Condensible PM	lb/hr		14.86	1.09		
		lb/hr					
		lb/hr					
	Emission factors (ENGLISH UNITS):						
	Total PM	lb/ton		9.94	3.30		6.62
	Filterable PM	lb/ton		6.53	3.05		4.79
	Condensible PM	lb/ton		3.41	0.25		1.83
		lb/ton					
		lb/ton					
	Emission factors (METRIC UNITS):						
	Total PM	kg/Mg		4.97	1.65		3.31
	Filterable PM	kg/Mg		3.27	1.53		2.40
	Condensible PM	kg/Mg		1.70	0.12		0.91
		kg/Mg					
		kg/Mg					

*DSCFM BASED ON A STANDARD TEMPERATURE OF 68 DEGREES FAHRENHEIT

- KCCO 7/27/96 YC

AIRSOURCE TECHNOLOGIES

September 16, 1996

Ms. Wanda Cobb
America Alfalfa Processors Assoc.
9948 W. 87th Street
Overland Park, KS 66212

Subject: Clarification of Sampling Locations for Project 411922

Dear Wanda:

There appears to be some confusion about the sampling locations at the following facilities:

- Lexington Alfalfa Dehydrators, Inc.
- Shofstall Alfalfa
- Gothenburg Feed Products Co.

The Shofstall sample location was in the outlet from the ID fan which is located immediately after the cyclone. The baghouse described in the report controlled emissions from another part of the process.

The Gothenburg facility also utilizes a cyclone. The testing was performed on the outlet duct of the cyclone. The baghouse referred to in the report controlled emissions from the hammermill.

The Lexington facility also utilized a cyclone to control emissions from the dryer. Once again the sample was collected from the outlet of this cyclone.

Once again, I apologize for the confusion between the process descriptions and the actual sample locations. If you have any further questions or need for clarification, please feel free to call me.

Sincerely,

George R. Cobb

George R. Cobb
President

AirSource Technologies · 11635 W. 83rd Terrace · Lenexa, KS 66215 · Phone (913) 492-1613 · Fax: (913) 492-1012

APPENDIX B

EXCERPTS FROM REFERENCE 6

(Shofstall Alfalfa, September 2, 1993)

SOURCE EMISSIONS REPORT
for
SHOFSTALL ALFALFA
Alfalfa Dehydration Facility
Odessa, Nebraska

prepared by
AirSource Technologies

11635 W. 83rd Terrace
Lenexa, Kansas 66214

AirSource Project No. 411922

PREFACE

This report was prepared by AirSource Technologies in response to a test that was conducted at the Shofstall Alfalfa Facility in Odessa, Nebraska on September 2, 1993. Any questions concerning this report should be directed to Mr. Blane Wood, Project Manager, or to Mr. George Cobb, General Manager.

AirSource Technologies

Blane Wood

Blane Wood
Project Manager

Approved

George R. Cobb

George R. Cobb
General Manager

Date: October 15, 1993

SECTION 2

SUMMARY OF RESULTS

The results of the particulate emissions are: 46.21 lb.hr, 36.26 lb/hr, and 29.93 lb/hr for Runs 1, 2 and 3 respectively.

The sampling and particulate results are shown in Table 1.

Table 1 SUMMARY OF SAMPLING AND PARTICULATE RESULTS Shofstall Alfalfa Odessa, Nebraska				
Parameters	**Unit of Measure**	**Run 1**	**Run 2**	**Run 3**
Particulate Emissions				
Front Half	gr/dscf	0.1091	0.0877	0.0739
Uncorrected	gr/dscf	0.4362	0.3071	0.2586
Corrected to 7% O_2	gr/dscf	0.8725	0.7018	0.5910
Emission Rate	lb/hr	46.21	36.26	29.93
Weight	grams	0.2680	0.2135	0.1788
Isokinetics	%	91.7	93.1	94.5
Stack Flow Rate				
Actual	acfm	77,333	78,339	79,515
Standard Conditions	dscfm	49,442	48,234	47,277
Velocity	ft/min.	6,154	6,234	6,328
Sampling Results				
Sampling Volume	dscf	37.841	37.478	37.278
Avg. Stack Temperature	°F	178	190	202
Avg. ΔP	inches H_2O	2.413	2.413	2.429
Avg. ΔH	inches H_2O	1.4	1.39	1.39
Avg. Meter Temperature	°F	69	72	79
Oxygen, Orsat	%	17.5	17.0	17.0
Carbon Dioxide, Orsat	%	1.5	1.5	1.5
Static Pressure	inches H_2O	0.85	0.85	0.85
Moisture Collected	ml	164.5	180.9	197.5
Moisture	% H_2O	17.0	18.5	20.0
Sampling Time	min.	60	60	60

SECTION 3

PROCESS OPERATION

The alfalfa dehydration plant operates a Heil 105 triple pass dryer. The control equipment used are a 2-Kire CK-126 cyclone and a single compartment baghouse. The condition for each of the test runs were the same. see p. B-13

Table 2 summarizes the results of the process operations and Table 3 provides process data collected during the tests.

Table 2 SUMMARY OF RESULTS Process Data	
Historical Average Process Weight (@ 30% moisture)	26,000 lb/hr
Historical Maximum Process Weight (@ 30% moisture)	32,000 lb/hr
Type of Fuel Normally Burned	Natural Gas
Approximate Quantity of Fuel Burned Annually	27,000 MCF
Baghouse - Positive pressure	
Number of Bags	144
Clean Cycle	3 minutes
Fan Rated H.P.	100 H.P.
Cyclone - 2-Kire CK-126	
Diameter	10.5 ft.
ΔP	3 in. H_2O
Fan Rated H.P.	125

FILE NAME - ODESSA.R1
RUN # - ODESSA.R1
LOCATION - DRYER STACK
DATE - SEPTEMBER 2, 1993
PROJECT # - 411922

PROG.=VER 06/27/89
09-29-1993 09:33:05

Initial Meter Volume (Cubic Feet)=	741.000
Final Meter Volume (Cubic Feet)=	780.938
Meter Factor=	1.019
Final Leak Rate (cu ft/min)=	0.002
Net Meter Volume (Cubic Feet)=	40.697
Gas Volume (Dry Standard Cubic Feet)=	37.841
Barometric Pressure (in Hg)=	27.79
Static Pressure (Inches H20)=	0.85
Percent Oxygen=	17.5
Percent Carbon Dioxide=	1.5
Moisture Collected (ml)=	164.5
Percent Water=	17.0
Average Meter Temperature (F)=	69
Average Delta H (in H20)=	1.40
Average Delta P (in H20)=	2.413
Average Stack Temperature (F)=	178
Dry Molecular Weight=	28.94
Wet Molecular Weight=	27.08
Average Square Root of Delta P (in H20)=	1.5530
% Isokinetic=	91.7
Pitot Coefficient=	0.84
Sampling Time (Minutes)=	60.0
Nozzle Diameter (Inches)=	0.179
Stack Axis #1 (Inches)=	48.0
Stack Axis #2 (Inches)=	48.0
Circular Stack	
Stack Area (Square Feet)=	12.57
Stack Velocity (Actual, Feet/min)=	6,154
Flow Rate (Actual, Cubic ft/min)=	77,333
Flow rate (Standard, Wet, Cubic ft/min)=	59,566
Flow Rate (Standard, Dry, Cubic ft/min)=	49,442

Particulate Loading - Front Half

		Corr. to 7% O2	& 12% CO2
Particulate Weight (g)=	0.2680		
Particulate Loading, Dry Std. (gr/scf)=	0.1091	0.4362	0.8725
Particulate Loading, Actual (gr/cu ft)=	0.0697		
Emission Rate (lb/hr)=	46.21		

Particulate Loading - Total Catch Including Impingers

Particulate Weight (g)=	0.2764		
Particulate Loading, Dry Std. (gr/scf)=	0.1125	0.4499	0.8998
Particulate Loading, Actual (gr/cu ft)=	0.0719		
Emission Rate (lb/hr)=	47.66		
Percent Impinger Catch=	3.0		

FILE NAME - ODESSA.R2
RUN # - ODESSA.R2
LOCATION - DRYER STACK
DATE - SEPTEMBER 2, 1993
PROJECT # - 411922

PROG.=VER 06/27/89
09-28-1993 16:00:46

Initial Meter Volume (Cubic Feet)=	782.453		
Final Meter Volume (Cubic Feet)=	822.238		
Meter Factor=	1.019		
Final Leak Rate (cu ft/min)=	0.002		
Net Meter Volume (Cubic Feet)=	40.541		
Gas Volume (Dry Standard Cubic Feet)=	37.478		
Barometric Pressure (in Hg)=	27.79		
Static Pressure (Inches H20)=	0.85		
Percent Oxygen=	17.0		
Percent Carbon Dioxide=	1.5		
Moisture Collected (ml)=	180.9		
Percent Water=	18.5		
Average Meter Temperature (F)=	72		
Average Delta H (in H20)=	1.39		
Average Delta P (in H20)=	2.413		
Average Stack Temperature (F)=	190		
Dry Molecular Weight=	28.92		
Wet Molecular Weight=	26.90		
Average Square Root of Delta P (in H20)=	1.5530		
% Isokinetic=	93.1		
Pitot Coefficient=	0.84		
Sampling Time (Minutes)=	60.0		
Nozzle Diameter (Inches)=	0.179		
Stack Axis #1 (Inches)=	48.0		
Stack Axis #2 (Inches)=	48.0		
Circular Stack			
Stack Area (Square Feet)=	12.57		
Stack Velocity (Actual, Feet/min)=	6,234		
Flow Rate (Actual, Cubic ft/min)=	78,339		
Flow rate (Standard, Wet, Cubic ft/min)=	59,200		
Flow Rate (Standard, Dry, Cubic ft/min)=	48,234		
Particulate Loading - Front Half			
		Corr. to 7% O2	& 12% CO2
Particulate Weight (g)=	0.2135		
Particulate Loading, Dry Std. (gr/scf)=	0.0877	0.3071	0.7018
Particulate Loading, Actual (gr/cu ft)=	0.0540		
Emission Rate (lb/hr)=	36.26		
Particulate Loading - Total Catch Including Impingers			
Particulate Weight (g)=	0.2213		
Particulate Loading, Dry Std. (gr/scf)=	0.0909	0.3183	0.7275
Particulate Loading, Actual (gr/cu ft)=	0.0560		
Emission Rate (lb/hr)=	37.59		
Percent Impinger Catch=	3.5		

FILE NAME - ODESSA.R3
RUN # - ODESSA.R3
LOCATION - DRYER STACK
DATE - SEPTEMBER 2, 1993
PROJECT # - 411922

PROG.=VER 06/27/89
09-28-1993 16:03:14

Initial Meter Volume (Cubic Feet)=	822.500
Final Meter Volume (Cubic Feet)=	862.605
Meter Factor=	1.019
Final Leak Rate (cu ft/min)=	0.004
Net Meter Volume (Cubic Feet)=	40.867
Gas Volume (Dry Standard Cubic Feet)=	37.278
Barometric Pressure (in Hg)=	27.79
Static Pressure (Inches H20)=	0.85
Percent Oxygen=	17.0
Percent Carbon Dioxide=	1.5
Moisture Collected (ml)=	197.5
Percent Water=	20.0
Average Meter Temperature (F)=	79
Average Delta H (in H20)=	1.39
Average Delta P (in H20)=	2.429
Average Stack Temperature (F)=	202
Dry Molecular Weight=	28.92
Wet Molecular Weight=	26.74
Average Square Root of Delta P (in H20)=	1.5583
% Isokinetic=	94.5
Pitot Coefficient=	0.84
Sampling Time (Minutes)=	60.0
Nozzle Diameter (Inches)=	0.179
Stack Axis #1 (Inches)=	48.0
Stack Axis #2 (Inches)=	48.0
Circular Stack	
Stack Area (Square Feet)=	12.57
Stack Velocity (Actual, Feet/min)=	6,328
Flow Rate (Actual, Cubic ft/min)=	79,515
Flow rate (Standard, Wet, Cubic ft/min)=	59,074
Flow Rate (Standard, Dry, Cubic ft/min)=	47,277

Particulate Loading - Front Half

		Corr. to 7% O2	& 12% CO2
Particulate Weight (g)=	0.1788		
Particulate Loading, Dry Std. (gr/scf)=	0.0739	0.2586	0.5910
Particulate Loading, Actual (gr/cu ft)=	0.0439		
Emission Rate (lb/hr)=	29.93		

Particulate Loading - Total Catch Including Impingers

Particulate Weight (g)=	0.1859		
Particulate Loading, Dry Std. (gr/scf)=	0.0768	0.2688	0.6145
Particulate Loading, Actual (gr/cu ft)=	0.0456		
Emission Rate (lb/hr)=	31.12		
Percent Impinger Catch=	3.8		

TO DATE 9-2-93

Pellets	
9:00	8.0
9:15	7.8
9:30	7.8
9:45	7.5
10:00	7.4
10:15	7.5
10:30	7.3
10:45	7.2
11:00	7.0
11:15	7.1
11:30	7.0
11:45	7.3
12:00	7.5

Green Hay

8:30	=	33%
9:00	=	34%
10:00	=	33%
11:00	=	35%
12:00	=	33%
1:00	=	33%
2:00	=	
3:00	=	

SCALE ← Pellet WEIGHT

9:00	=	2	TON
9:15	=	1.5	''
9:30	=	1.7	''
9:45	=	1.7	''
10:00	=	1.8	''
10:15	=	1.9	''
10:30	=	2.1	''
10:45	=	2.1	''
11:00	=	2.2	''
11:15	=	1.9	''
11:30	=	2.2	''
11:45	=	2.0	''
12:00	=	2.2	''

BY

GREIF BROS. CONTAINERS

TO DATE

	PELLETS	SCALE		
12:15	7.0	2.0	=	TON
12:30	7.0	2.4	=	''
12:45	7.1	2.3	=	''
1:00	7.3	2.3	=	''
1:15			=	''
1:30			=	''
1:45			=	''
2:00			=	''
2:15			=	''
2:30			=	''
2:45			=	''
3:00			=	''

17 | 34.3 tons

ave. = 2.018 tons per 15 min.

2.018 × 4 =

8.07 tons/hr. of finished pellets.

BY

GREIF BROS. CONTAINERS

American Alfalfa Processors Association
9948 West 87th Street, Suite E
Overland Park, Kansas 66212
Telephone 913-648-6800

AAPA

March 15, 1996

To: Tom Lapp

From: Wanda Cobb

Tom, per my telephone conversation with Larry Durfee, manager of Shofetall Alfalfa, Odessa, Nebraska, the average 8.068 tons per hour production rate shown in the test data is fininshed pellet weight.

Wanda Cobb

Filename:
Date:
Facility: SHOFSTALL ALFALFA
Location: Odessa, Nebraska
Source: Dryer cyclone exhaust
Test date: September 2, 1993

GAS-FIRED DRYER
TRIPLE-PASS

D. Emission Data/Mass Flux Rates/Emission Factors

Test ID	Parameter	Units	Values reported Run 1	Run 2	Run 3	Run 4	AVERAGE
	Stack temperature	Deg F	178	190	202		
	Pressure	in. HG	27.79	27.79	27.79		
	Moisture	%	17.0	18.5	20.0		
	Oxygen	%	17.5	17.0	17.0		
	Volumetric flow, actual	acfm	77,333	78,339	79,515		
	Volumetric flow, standard*	dscfm	49,442	48,234	47,277		
	Isokinetic variation	%	91.7	93.1	94.5		
Circle: Production or feed rate Capacity: Pellet		TPH	8	8	8		
	Pollutant concentrations:						
	Total PM	G/dscf	0.1125	0.0909	0.0768		
	Filterable PM	G/dscf	0.1091	0.0877	0.0739		
	Condensible PM	G/dscf	0.0034	0.0032	0.0029		
	Pollutant mass flux rates:						
	Total PM	lb/hr	47.66	37.59	31.12		
	Filterable PM	lb/hr	46.21	36.26	29.93		
	Condensible PM	lb/hr	1.45	1.33	1.19		
		lb/hr					
		lb/hr					
	Emission factors (ENGLISH UNITS):						
	Total PM	lb/ton	5.96	4.70	3.89		4.85
	Filterable PM	lb/ton	5.78	4.53	3.74		4.68
	Condensible PM	lb/ton	0.18	0.17	0.15		0.17
		lb/ton					
		lb/ton					
	Emission factors (METRIC UNITS):						
	Total PM	kg/Mg	2.98	2.35	1.95		2.43
	Filterable PM	kg/Mg	2.89	2.27	1.87		2.34
	Condensible PM	kg/Mg	0.09	0.08	0.08		0.08
		kg/Mg					
		kg/Mg					

*DSCFM BASED ON A STANDARD TEMPERATURE OF 68 DEGREES FAHRENHEIT

,CCCs 1,2-, 7- YC

AIRSOURCE TECHNOLOGIES

September 16, 1996

Ms. Wanda Cobb
America Alfalfa Processors Assoc.
9948 W. 87th Street
Overland Park, KS 66212

Subject: Clarification of Sampling Locations for Project 411922

Dear Wanda:

There appears to be some confusion about the sampling locations at the following facilities:

- Lexington Alfalfa Dehydrators, Inc.
- Shofstall Alfalfa
- Gothenburg Feed Products Co.

The Shofstall sample location was in the outlet from the ID fan which is located immediately after the cyclone. The baghouse described in the report controlled emissions from another part of the process.

The Gothenburg facility also utilizes a cyclone. The testing was performed on the outlet duct of the cyclone. The baghouse referred to in the report controlled emissions from the hammermill.

The Lexington facility also utilized a cyclone to control emissions from the dryer. Once again the sample was collected from the outlet of this cyclone.

Once again, I apologize for the confusion between the process descriptions and the actual sample locations. If you have any further questions or need for clarification, please feel free to call me.

Sincerely,

George R. Cobb
President

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APPENDIX C

EXCERPTS FROM REFERENCE 7

(Morrison & Quirk, Inc., September 8, 1993)

PLANT #3

SOURCE EMISSIONS REPORT
for
MORRISON & QUIRK, INC.
Alfalfa Dehydration Facility
Lyons, Nebraska

prepared by
AirSource Technologies

11635 W. 83rd Terrace
Lenexa, Kansas 66214

AirSource Project No. 411922

PREFACE

This report was prepared by AirSource Technologies in response to a test that was conducted at the Morrison & Quirk, Inc. in Lyons, Nebraska on September 8, 1993. Any questions concerning this report should be directed to Mr. Blane Wood, Project Manager, or to Mr. George Cobb, General Manager.

AirSource Technologies

Blane Wood

Blane Wood
Project Manager

Approved

George R. Cobb
General Manager

Date: October 15, 1993

SECTION 2

SUMMARY OF RESULTS

The results of the particulate emissions are: 3.93 lb.hr, 4.92 lb/hr, and 6.56 lb/hr for Runs 1, 2 and 3 respectively.

The sampling, and particulate results are shown in Table 1.

Table 1 SUMMARY OF SAMPLING AND PARTICULATE RESULTS Morrison & Quirk, Inc. Lyons, Nebraska				
Parameters	**Unit of Measure**	**Run 1**	**Run 2**	**Run 3**
Particulate Emissions				
Front Half	gr/dscf	0.0449	0.0557	0.0800
Uncorrected	gr/dscf	0.1048	0.1558	0.2801
Corrected to 7% O_2	gr/dscf	0.3593	0.6679	0.9603
Emission Rate	lb/hr	3.93	4.92	6.56
Weight	grams	0.0931	0.1187	0.1651
Isokinetics	%	97.7	99.4	103.8
Stack Flow Rate				
Actual	acfm	14,874	15,447	15,286
Standard Conditions	dscfm	10,215	10,321	9,563
Velocity	ft/min.	2,504	2,601	2,574
Sampling Results				
Sampling Volume	dscf	31.925	32.841	31.776
Avg. Stack Temperature	°F	184	187	192
Avg. ΔP	inches H_2O	0.416	0.442	0.423
Avg. ΔH	inches H_2O	0.93	1.00	0.97
Avg. Meter Temperature	°F	65	75	89
Oxygen, Orsat	%	15.0	16.0	17.0
Carbon Dioxide, Orsat	%	1.5	1.0	1.0
Static Pressure	inches H_2O	0.25	0.25	0.25
Moisture Collected	ml	101.6	122.9	166.8
Moisture	% H_2O	13.0	15.0	19.8
Sampling Time	min.	60	60	60

SECTION 3

PROCESS OPERATION

The alfalfa dehydration plant is a 10 x 36 single pass with an 8 foot inlet cone. The control equipment used to control emissions is a 10 foot diameter cyclone. The condition for each of the test runs were the same.

Table 2 summarizes the results of the process operations and Table 3 provides process data collected during the tests.

Table 2 SUMMARY OF RESULTS Process Data	
Maximum Continuous Process Weight (Manufacturers Rating)	7 T/hr
Historical Average Process Weight	5 T/hr
Historical Maximum Process Weight	7 T/hr
Type of Fuel Normally Burned	Natural Gas
Approximate Quantity of Fuel Burned	20,000 MCF
Process Data During Test	
Process Weight (Dry)	10,000 lb/hr alfalfa
Percent Moisture	27%
Process Weight (Wet)	1,700 lb/hr water
How Process Weight Determined	Moisture Balance
Recycling in Progress	50% to 75%
Cyclone - negative - 10 ft.	
ΔP	4 in. H_2O
Fan Rated H.P.	100 H.P.
Operating Volts	440 Volts
Operating Amps	75 amps

Table 3 PROCESS DATA					
	Drum Tail °F	Furnace °F	TPH	Pellet Moisture %	Drumtail Vac in. H_2O
10:00	220	850	5	7.8	4
10:30	220	850	5	7.8	4
11:00	220	850	4 3/4	7.8	4
11:30	220	800	5	7.7	4
12:00	220	850	5	7.8	4
12:30	220	850	5	7.9	4
13:00	220	850	4 3/4	7.8	4
13:30	230	1000	5	7.8	4
14:00	230	1100	5	7.7	4
14:30	230	1050	6	7.9	4
15:00	235	1150	6	7.5	4
15:20	235	1150	6	7.4	4

Av. = 5.21 TPH

FILE NAME - LYONS.R1
RUN # - LYONS RUN 1
LOCATION - DRYER STACK
DATE - SEPTEMBER 8, 1993
PROJECT # - 411922

PROG.=VER 06/27/89
09-29-1993 15:03:46

Initial Meter Volume (Cubic Feet)=	123.200
Final Meter Volume (Cubic Feet)=	157.120
Meter Factor=	0.970
Final Leak Rate (cu ft/min)=	0.000
Net Meter Volume (Cubic Feet)=	32.902
Gas Volume (Dry Standard Cubic Feet)=	31.925
Barometric Pressure (in Hg)=	28.80
Static Pressure (Inches H20)=	0.25
Percent Oxygen=	15.0
Percent Carbon Dioxide=	1.5
Moisture Collected (ml)=	101.6
Percent Water=	13.0
Average Meter Temperature (F)=	65
Average Delta H (in H20)=	0.93
Average Delta P (in H20)=	0.416
Average Stack Temperature (F)=	184
Dry Molecular Weight=	28.84
Wet Molecular Weight=	27.43
Average Square Root of Delta P (in H20)=	0.6439
% Isokinetic=	97.7
Pitot Coefficient=	0.84
Sampling Time (Minutes)=	60.0
Nozzle Diameter (Inches)=	0.241
Stack Axis #1 (Inches)=	33.0
Stack Axis #2 (Inches)=	33.0
Circular Stack	
Stack Area (Square Feet)=	5.94
Stack Velocity (Actual, Feet/min)=	2,504
Flow Rate (Actual, Cubic ft/min)=	14,874
Flow rate (Standard, Wet, Cubic ft/min)=	11,746
Flow Rate (Standard, Dry, Cubic ft/min)=	10,215

Particulate Loading - Front Half

		Corr. to 7% O2	& 12% CO2
Particulate Weight (g)=	0.0931		
Particulate Loading, Dry Std. (gr/scf)=	0.0449	0.1048	0.3593
Particulate Loading, Actual (gr/cu ft)=	0.0308		
Emission Rate (lb/hr)=	3.93		

Particulate Loading - Total Catch Including Impingers

Particulate Weight (g)=	0.1098		
Particulate Loading, Dry Std. (gr/scf)=	0.0530	0.1236	0.4238
Particulate Loading, Actual (gr/cu ft)=	0.0364		
Emission Rate (lb/hr)=	4.64		
Percent Impinger Catch=	15.2		

FILE NAME - LYONS.R2
RUN # - LYONS RUN 2
LOCATION - DRYER STACK
DATE - SEPTEMBER 8, 1993
PROJECT # - 411922

PROG.=VER 06/27/89
09-28-1993 16:14:28

Initial Meter Volume (Cubic Feet)=	157.260		
Final Meter Volume (Cubic Feet)=	192.845		
Meter Factor=	0.970		
Final Leak Rate (cu ft/min)=	0.003		
Net Meter Volume (Cubic Feet)=	34.517		
Gas Volume (Dry Standard Cubic Feet)=	32.841		
Barometric Pressure (in Hg)=	28.80		
Static Pressure (Inches H2O)=	0.25		
Percent Oxygen=	16.0		
Percent Carbon Dioxide=	1.0		
Moisture Collected (ml)=	122.9		
Percent Water=	15.0		
Average Meter Temperature (F)=	75		
Average Delta H (in H2O)=	1.00		
Average Delta P (in H2O)=	0.442		
Average Stack Temperature (F)=	187		
Dry Molecular Weight=	28.80		
Wet Molecular Weight=	27.18		
Average Square Root of Delta P (in H2O)=	0.6642		
% Isokinetic=	99.4		
Pitot Coefficient=	0.84		
Sampling Time (Minutes)=	60.0		
Nozzle Diameter (Inches)=	0.241		
Stack Axis #1 (Inches)=	33.0		
Stack Axis #2 (Inches)=	33.0		
Circular Stack			
Stack Area (Square Feet)=	5.94		
Stack Velocity (Actual, Feet/min)=	2,601		
Flow Rate (Actual, Cubic ft/min)=	15,447		
Flow rate (Standard, Wet, Cubic ft/min)=	12,140		
Flow Rate (Standard, Dry, Cubic ft/min)=	10,321		
Particulate Loading - Front Half			
Particulate Weight (g)=	0.1187	Corr. to 7% O2 & 12% CO2	
Particulate Loading, Dry Std. (gr/scf)=	0.0557	0.1558	0.6679
Particulate Loading, Actual (gr/cu ft)=	0.0372		
Emission Rate (lb/hr)=	4.92		
Particulate Loading - Total Catch Including Impingers			
Particulate Weight (g)=	0.1432		
Particulate Loading, Dry Std. (gr/scf)=	0.0671	0.1880	0.8058
Particulate Loading, Actual (gr/cu ft)=	0.0448		
Emission Rate (lb/hr)=	5.94		
Percent Impinger Catch=	17.1		

FILE NAME - LYONS.R3
RUN # - LYONS RUN 3
LOCATION - DRYER STACK
DATE - SEPTEMBER 8, 1993
PROJECT # - 411922

PROG.=VER 06/27/89
09-28-1993 16:16:27

Initial Meter Volume (Cubic Feet)=	193.080		
Final Meter Volume (Cubic Feet)=	228.380		
Meter Factor=	0.970		
Final Leak Rate (cu ft/min)=	0.005		
Net Meter Volume (Cubic Feet)=	34.241		
Gas Volume (Dry Standard Cubic Feet)=	31.776		
Barometric Pressure (in Hg)=	28.80		
Static Pressure (Inches H20)=	0.25		
Percent Oxygen=	17.0		
Percent Carbon Dioxide=	1.0		
Moisture Collected (ml)=	166.8		
Percent Water=	19.8		
Average Meter Temperature (F)=	89		
Average Delta H (in H20)=	0.97		
Average Delta P (in H20)=	0.423		
Average Stack Temperature (F)=	192		
Dry Molecular Weight=	28.84		
Wet Molecular Weight=	26.69		
Average Square Root of Delta P (in H20)=	0.6490		
% Isokinetic=	103.8		
Pitot Coefficient=	0.84		
Sampling Time (Minutes)=	60.0		
Nozzle Diameter (Inches)=	0.241		
Stack Axis #1 (Inches)=	33.0		
Stack Axis #2 (Inches)=	33.0		
Circular Stack			
Stack Area (Square Feet)=	5.94		
Stack Velocity (Actual, Feet/min)=	2,574		
Flow Rate (Actual, Cubic ft/min)=	15,286		
Flow rate (Standard, Wet, Cubic ft/min)=	11,928		
Flow Rate (Standard, Dry, Cubic ft/min)=	9,563		
Particulate Loading - Front Half			
		Corr. to 7% O2	& 12% CO2
Particulate Weight (g)=	0.1651		
Particulate Loading, Dry Std. (gr/scf)=	0.0800	0.2801	0.9603
Particulate Loading, Actual (gr/cu ft)=	0.0500		
Emission Rate (lb/hr)=	6.56		
Particulate Loading - Total Catch Including Impingers			
Particulate Weight (g)=	0.2089		
Particulate Loading, Dry Std. (gr/scf)=	0.1012	0.3544	1.2149
Particulate Loading, Actual (gr/cu ft)=	0.0633		
Emission Rate (lb/hr)=	8.30		
Percent Impinger Catch=	21.0		

Filename:
Date:
Facility: Morrison & Quirk, Inc.
Location: Lyons, Nebraska
Source: Dryer Cyclone Exhaust
Test date: September 8, 1993

Gas-Fired Dryer
Single-Pass

D. Emission Data/Mass Flux Rates/Emission Factors

Test ID	Parameter	Units	Run 1	Run 2	Run 3	Run 4	AVERAGE
	Stack temperature	Deg F	184	187	192		
	Pressure	in. HG	28.8	28.8	28.8		
	Moisture	%	13.0	15.0	19.8		
	Oxygen	%	15.0	16.0	17.0		
	Volumetric flow, actual	acfm	14,874	15,447	15,286		
	Volumetric flow, standard*	dscfm	10,215	10,321	9,563		
	Isokinetic variation	%	97.7	99.4	103.8		
Circle: Production or feed rate Capacity: Pellet		TPH	5.2	5.2	5.2		
	Pollutant concentrations:						
	Total PM	G/dscf	0.0530	0.0671	0.1012		
	Filterable PM	G/dscf	0.0449	0.0557	0.0800		
	Condensible PM	G/dscf	0.0081	0.0114	0.0212		
	Pollutant mass flux rates:						
	Total PM	lb/hr	4.64	5.94	8.30		
	Filterable PM	lb/hr	3.93	4.92	6.56		
	Condensible PM	lb/hr	0.71	1.02	1.74		
		lb/hr					
		lb/hr					
	Emission factors (ENGLISH UNITS):						
	Total PM	lb/ton	0.89	1.14	1.60		1.21
	Filterable PM	lb/ton	0.76	0.95	1.26		0.99
	Condensible PM	lb/ton	0.13	0.19	0.34		0.22
		lb/ton					
		lb/ton					
	Emission factors (METRIC UNITS):						
	Total PM	kg/Mg	0.45	0.57	0.80		0.61
	Filterable PM	kg/Mg	0.38	0.48	0.63		0.50
	Condensible PM	kg/Mg	0.07	0.09	0.17		0.11
		kg/Mg					
		kg/Mg					

*DSCFM BASED ON A STANDARD TEMPERATURE OF 68 DEGREES FAHRENHEIT

APPENDIX D

EXCERPTS FROM REFERENCE 8

(Lexington Alfalfa Dehydrators, Inc., September 9, 1993)

PLANT #4

SOURCE EMISSIONS REPORT
for
LEXINGTON ALFALFA DEHYDRATORS, INC.
Alfalfa Dehydration Facility
Darr, Nebraska

prepared by
AirSource Technologies

11635 W. 83rd Terrace
Lenexa, Kansas 66214

AirSource Project No. 411922

PREFACE

This report was prepared by AirSource Technologies in response to a test that was conducted at the Lexington Alfalfa Dehydrators, Inc. in Darr, Nebraska on September 9, 1993. Any questions concerning this report should be directed to Mr. Blane Wood, Project Manager, or to Mr. George Cobb, General Manager.

AirSource Technologies

Blane Wood

Blane Wood
Project Manager

Approved

George R. Cobb

George R. Cobb
General Manager

Date: October 15, 1993

SECTION 2

SUMMARY OF RESULTS

The results of the particulate emissions are: 57.52 lb.hr, 26.21 lb/hr, and 24.47 lb/hr for Runs 1, 2 and 3 respectively.

The sampling, and particulate results are shown in Table 1.

Table 1
SUMMARY OF SAMPLING AND PARTICULATE RESULTS
Lexington Alfalfa Dehyrateors, Inc.
Darr, Nebraska

Parameters	Unit of Measure	Run 1	Run 2	Run 3
Particulate Emissions				
Front Half	gr/dscf	0.2453	0.1191	0.1127
Uncorrected	gr/dscf	0.8587	0.4764	0.3945
Corrected to 7% O_2	gr/dscf	1.9627	0.9528	1.3527
Emission Rate	lb/hr	57.52	26.21	24.47
Weight	grams	0.5695	0.2663	0.2492
Isokinetics	%	92.2	94.6	94.8
Stack Flow Rate				
Actual	acfm	36,649	36,323	36,279
Standard Conditions	dscfm	27,355	25,680	25,333
Velocity	ft/min.	5,185	5,139	5,132
Sampling Results				
Sampling Volume	dscf	35.749	34.433	34.052
Avg. Stack Temperature	°F	153	168	172
Avg. ΔP	inches H_2O	1.850	1.758	1.733
Avg. ΔH	inches H_2O	1.25	1.17	1.11
Avg. Meter Temperature	°F	81	82	79
Oxygen, Orsat	%	17.0	17.5	17.0
Carbon Dioxide, Orsat	%	1.5	1.5	1.0
Static Pressure	inches H_2O	0.62	0.62	0.62
Moisture Collected	ml	52.5	75.5	79.4
Moisture	% H_2O	6.5	9.4	9.9
Sampling Time	min.	60	60	60

SECTION 3

PROCESS OPERATION

The alfalfa dehydration plant operates a MEC 125 single pass dryer. No control device was in operation at the time of testing. The conditions for each of the test runs were the same.

see p. D-11

Table 2 summarizes the results of the process operations and table 3 process data collected during the tests.

Table 2 SUMMARY OF RESULTS Process Data	
Maximum Continuous Process Weight (Manufacturers Rating)	20,000 lb/hr
Historical Average Process Weight	10,000 lb/hr
Historical Maximum Process Weight	16,000 lb/hr
Type of Fuel Normally Burned	Natural Gas
Approximate Quantity of Fuel Burned Annually	27,000 MCF
Percent Moisture	46% Hay Pile

FILE NAME - DARR.R1
RUN # - DARR RUN 1
LOCATION - DRYER STACK
DATE - SEPTEMBER 9, 1993
PROJECT # - 411922

PROG.=VER 06/27/89
09-28-1993 16:07:29

Initial Meter Volume (Cubic Feet)=	228.475		
Final Meter Volume (Cubic Feet)=	269.178		
Meter Factor=	0.970		
Final Leak Rate (cu ft/min)=	0.006		
Net Meter Volume (Cubic Feet)=	39.482		
Gas Volume (Dry Standard Cubic Feet)=	35.749		
Barometric Pressure (in Hg)=	27.69		
Static Pressure (Inches H20)=	0.62		
Percent Oxygen=	17.0		
Percent Carbon Dioxide=	1.5		
Moisture Collected (ml)=	52.5		
Percent Water=	6.5		
Average Meter Temperature (F)=	81		
Average Delta H (in H20)=	1.25		
Average Delta P (in H20)=	1.850		
Average Stack Temperature (F)=	153		
Dry Molecular Weight=	28.92		
Wet Molecular Weight=	28.21		
Average Square Root of Delta P (in H20)=	1.3594		
% Isokinetic=	92.2		
Pitot Coefficient=	0.84		
Sampling Time (Minutes)=	60.0		
Nozzle Diameter (Inches)=	0.175		
Stack Axis #1 (Inches)=	36.0		
Stack Axis #2 (Inches)=	36.0		
Circular Stack			
Stack Area (Square Feet)=	7.07		
Stack Velocity (Actual, Feet/min)=	5,185		
Flow Rate (Actual, Cubic ft/min)=	36,649		
Flow rate (Standard, Wet, Cubic ft/min)=	29,247		
Flow Rate (Standard, Dry, Cubic ft/min)=	27,355		
Particulate Loading - Front Half			
		Corr. to 7% O2	& 12% CO2
Particulate Weight (g)=	0.5695		
Particulate Loading, Dry Std. (gr/scf)=	0.2453	0.8587	1.9627
Particulate Loading, Actual (gr/cu ft)=	0.1830		
Emission Rate (lb/hr)=	57.52		
Particulate Loading - Total Catch Including Impingers			
Particulate Weight (g)=	0.5832		
Particulate Loading, Dry Std. (gr/scf)=	0.2512	0.8794	2.0100
Particulate Loading, Actual (gr/cu ft)=	0.1875		
Emission Rate (lb/hr)=	58.90		
Percent Impinger Catch=	2.4		

FILE NAME - DARR.R2
RUN # - DARR RUN 2
LOCATION - DRYER STACK
DATE - SEPTEMBER 9, 1993
PROJECT # - 411922

PROG.=VER 06/27/89
09-28-1993 16:08:50

Initial Meter Volume (Cubic Feet)=	269.332
Final Meter Volume (Cubic Feet)=	308.597
Meter Factor=	0.970
Final Leak Rate (cu ft/min)=	0.000
Net Meter Volume (Cubic Feet)=	38.087
Gas Volume (Dry Standard Cubic Feet)=	34.433
Barometric Pressure (in Hg)=	27.69
Static Pressure (Inches H20)=	0.62
Percent Oxygen=	17.5
Percent Carbon Dioxide=	1.5
Moisture Collected (ml)=	75.5
Percent Water=	9.4
Average Meter Temperature (F)=	82
Average Delta H (in H20)=	1.17
Average Delta P (in H20)=	1.758
Average Stack Temperature (F)=	168
Dry Molecular Weight=	28.94
Wet Molecular Weight=	27.92
Average Square Root of Delta P (in H20)=	1.3249
% Isokinetic=	94.6
Pitot Coefficient=	0.84
Sampling Time (Minutes)=	60.0
Nozzle Diameter (Inches)=	0.175
Stack Axis #1 (Inches)=	36.0
Stack Axis #2 (Inches)=	36.0
Circular Stack	
Stack Area (Square Feet)=	7.07
Stack Velocity (Actual, Feet/min)=	5,139
Flow Rate (Actual, Cubic ft/min)=	36,323
Flow rate (Standard, Wet, Cubic ft/min)=	28,332
Flow Rate (Standard, Dry, Cubic ft/min)=	25,680

Particulate Loading - Front Half

		Corr. to 7% O2	& 12% CO2
Particulate Weight (g)=	0.2663		
Particulate Loading, Dry Std. (gr/scf)=	0.1191	0.4764	0.9528
Particulate Loading, Actual (gr/cu ft)=	0.0842		
Emission Rate (lb/hr)=	26.21		

Particulate Loading - Total Catch Including Impingers

Particulate Weight (g)=	0.2851		
Particulate Loading, Dry Std. (gr/scf)=	0.1275	0.5100	1.0201
Particulate Loading, Actual (gr/cu ft)=	0.0901		
Emission Rate (lb/hr)=	28.06		
Percent Impinger Catch=	6.6		

FILE NAME - DARR.R3
RUN # - DARR RUN 3
LOCATION - DRYER STACK
DATE - SEPTEMBER 9, 1993
PROJECT # - 411922

PROG.=VER 06/27/89
09-29-1993 10:03:16

Initial Meter Volume (Cubic Feet)=	308.738
Final Meter Volume (Cubic Feet)=	347.350
Meter Factor=	0.970
Final Leak Rate (cu ft/min)=	0.000
Net Meter Volume (Cubic Feet)=	37.454
Gas Volume (Dry Standard Cubic Feet)=	34.052
Barometric Pressure (in Hg)=	27.69
Static Pressure (Inches H20)=	0.62
Percent Oxygen=	17.0
Percent Carbon Dioxide=	1.0
Moisture Collected (ml)=	79.4
Percent Water=	9.9
Average Meter Temperature (F)=	79
Average Delta H (in H20)=	1.11
Average Delta P (in H20)=	1.733
Average Stack Temperature (F)=	172
Dry Molecular Weight=	28.84
Wet Molecular Weight=	27.77
Average Square Root of Delta P (in H20)=	1.3155
% Isokinetic=	94.8
Pitot Coefficient=	0.84
Sampling Time (Minutes)=	60.0
Nozzle Diameter (Inches)=	0.175
Stack Axis #1 (Inches)=	36.0
Stack Axis #2 (Inches)=	36.0
Circular Stack	
Stack Area (Square Feet)=	7.07
Stack Velocity (Actual, Feet/min)=	5,132
Flow Rate (Actual, Cubic ft/min)=	36,279
Flow rate (Standard, Wet, Cubic ft/min)=	28,115
Flow Rate (Standard, Dry, Cubic ft/min)=	25,333

Particulate Loading - Front Half

		Corr. to 7% O2	& 12% CO2
Particulate Weight (g)=	0.2492		
Particulate Loading, Dry Std. (gr/scf)=	0.1127	0.3945	1.3527
Particulate Loading, Actual (gr/cu ft)=	0.0787		
Emission Rate (lb/hr)=	24.47		

Particulate Loading - Total Catch Including Impingers

Particulate Weight (g)=	0.3795		
Particulate Loading, Dry Std. (gr/scf)=	0.1716	0.6006	2.0593
Particulate Loading, Actual (gr/cu ft)=	0.1198		
Emission Rate (lb/hr)=	37.26		
Percent Impinger Catch=	34.3		

Filename:
Date:
Facility: Lexington Alfalfa Dehydrators, Inc.
Location: Darr, Nebraska
Source: Dryer Exhaust - Uncontrolled
Test date: September 9, 1993

Gas-Fired Dryer
Single-Pass

D. Emission Data/Mass Flux Rates/Emission Factors

Test ID	Parameter	Units	Run 1	Run 2	Run 3	Run 4	AVERAGE
	Stack temperature	Deg F	153	168	172		
	Pressure	in. HG	27.69	27.69	27.69		
	Moisture	%	6.5	9.4	9.9		
	Oxygen	%	17.0	17.5	17.0		
	Volumetric flow, actual	acfm	36,649	36,323	36,279		
	Volumetric flow, standard*	dscfm	27,355	25,680	25,333		
	Isokinetic variation	%	92.2	94.6	94.8		
Circle: Production or feed rate Capacity: Pellet		TPH	5	5	5		
	Pollutant concentrations:						
	Total PM	G/dscf	0.2512	0.1275	0.1716		
	Filterable PM	G/dscf	0.2453	0.1191	0.1127		
	Condensible PM	G/dscf	0.0059	0.0084	0.0589		
	Pollutant mass flux rates:						
	Total PM	lb/hr	58.90	28.06	37.26		
	Filterable PM	lb/hr	57.52	26.21	24.47		
	Condensible PM	lb/hr	1.38	1.85	12.79		
		lb/hr					
		lb/hr					
	Emission factors (ENGLISH UNITS):						
	Total PM	lb/ton	11.78	5.61	7.45		8.28
	Filterable PM	lb/ton	11.50	5.24	4.89		7.21
	Condensible PM	lb/ton	0.28	0.37	2.56		1.07
		lb/ton					
		lb/ton					
	Emission factors (METRIC UNITS):						
	Total PM	kg/Mg	5.89	2.81	3.73		4.14
	Filterable PM	kg/Mg	5.75	2.62	2.45		3.61
	Condensible PM	kg/Mg	0.14	0.19	1.28		0.54
		kg/Mg					
		kg/Mg					

*DSCFM BASED ON A STANDARD TEMPERATURE OF 68 DEGREES FAHRENHEIT

Recd 1/27/?? YL

AIRSOURCE TECHNOLOGIES

September 16, 1996

Ms. Wanda Cobb
America Alfalfa Processors Assoc.
9948 W. 87th Street
Overland Park, KS 66212

Subject: Clarification of Sampling Locations for Project 411922

Dear Wanda:

There appears to be some confusion about the sampling locations at the following facilities:

- Lexington Alfalfa Dehydrators, Inc.
- Shofstall Alfalfa
- Gothenburg Feed Products Co.

The Shofstall sample location was in the outlet from the ID fan which is located immediately after the cyclone. The baghouse described in the report controlled emissions from another part of the process.

The Gothenburg facility also utilizes a cyclone. The testing was performed on the outlet duct of the cyclone. The baghouse referred to in the report controlled emissions from the hammermill.

The Lexington facility also utilized a cyclone to control emissions from the dryer. Once again the sample was collected from the outlet of this cyclone.

Once again, I apologize for the confusion between the process descriptions and the actual sample locations. If you have any further questions or need for clarification, please feel free to call me.

Sincerely,

George R. Cobb
President

AirSource Technologies • 11635 W. 83rd Terrace • Lenexa, KS 66215 • Phone (913) 492-1613 • Fax: (913) 492-1012

APPENDIX E

EXCERPTS FROM REFERENCE 9

(Verhoff Alfalfa Mills, Inc., September 18, 1992)

affiliated Environmental services, inc.

Verhoff Alfalfa
Attn: Mr. Don Verhoff
P.O. Box 87
Ottawa, OH 45875

REPORT TO VERHOFF ALFALFA

ON

STACK PARTICULATE SAMPLES
COLLECTED AT
HOYTVILLE, OH

SUBMITTED BY

AFFILIATED ENVIRONMENTAL SERVICES, INC.
3606 VENICE RD.
SANDUSKY, OH 44870

DATE OF TESTING: 9-18-92

DATE OF REPORT: 9-25-92

Joe Gillingham	Don Dauch
FIELD TEST SUPERVISOR	MANAGER, AIR SAMPLING DIVISION

3606 Venice Road • Sandusky, Ohio 44870 • (419) 627-1976 • FAX: (419) 625-3753

INTRODUCTION

This report contains the results of stack particulate and NO_x emission testing performed by Affiliated Environmental Services, Inc. for Verhoff Alfalfa Mills, Inc. Hoytville, OH. Testing was performed on 9~~8~~-18-92 on the outlet stack. Hay from hoppers, is fed into a drum and is dried. The air from the drum is then drawn through a cyclone and exhausted out a 42" inch diameter stack.

Fuel ?

Waste wood

Single-pass dryer ? yes

STACK PARTICULATE DATA AND NO_X DATA SUMMARY

Test No.	gr/dscf (A)	x1-$^{-6}$ lbs/dscf (B)	lbs/hr	NO_x lbs/hr
1	0.0568	8.1368	14.66	<0.29
2	0.0667	9.5456	17.23	AU <0.27
3	0.0813	11.6454	21.04	TONHOWK <0.27

TOTAL

(A) = Grains per dry standard cubic feet at 68°F and 29.92 inches Hg

(B) = Pounds per dry standard cubic feet at 68°F and 29.92 inches Hg

AFFILIATED ENVIRONMENTAL SERVICES, INC.
3606 VENICE RD.
SANDUSKY, OHIO 44870

PLANT NAME: Verhoff Alfalfa

DATE OF TEST: 9-18-92

STACK SAMPLING PARAMETERS

TEST RUN NUMBER 1

MINUTES OF TEST	60
VOLUME OF GAS COLLECTED cubic feet	37.988
METER CALIBRATION FACTOR Y	.99
BAROMETRIC PRESSURE	29.95
PRESSURE DIFFERENTIAL ACROSS ORIFICE DELTA H	1.21
METER TEMPERATURE (+460)	562
STACK STATIC PRESSURE (HG)	.0294
STACK TEMPERATURE (+460)	654
AVERAGE SQUARE ROOT OF VELOCITY HEAD	1.14
VOLUME OF IMPINGER WATER COLLECTED ml	95
WEIGHT OF SILICA COLLECTED gms	5
AREA OF SAMPLING NOZZLE square feet	.0001917
PITOT TUBE COEFFICIENT	.84
AREA OF STACK square feet	9.621
CARBON DIOXIDE (DRY FRACTION)	0
CARBON MONOXIDE (DRY FRACTION)	0
OXYGEN (DRY FRACTION)	21
NITROGEN (DRY FRACTION)	79

STACK PARTICULATE DATA

GAS VOLUME STANDARD CONDITIONS DSCF	35.459
VOLUME OF WATER VAPOR cubic feet	4.71
PERCENT MOISTURE IN STACK GAS	11.7
DRY GAS MOLECULAR WEIGHT	28.84
STACK GAS MOLECULAR WEIGHT	27.572
VELOCITY OF STACK GAS feet per second	72.81
FLOW RATE OF STACK GAS DSCFH	1801325
FLOW RATE OF STACK GAS DSCFM	30022
ISOKINICITY %	98.9
WEIGHT GAIN OF IMPINGERS mg	65.4
WEIGHT GAIN OF FILTER mg	91.9
WEIGHT GAIN OF PROBE WASH mg	39.1
PARTICULATES COLLECTED POUNDS/HOUR	14.66
PARTICULATES COLLECTED GRAINS/DSCF	.0568
PARTICULATES COLLECTED POUNDS/DSCF	8.1368E-06

AFFILIATED ENVIRONMENTAL SERVICES, INC.
3606 VENICE RD.
SANDUSKY, OHIO 44870

PLANT NAME: Verhoff Alfalfa

DATE OF TEST: 9-18-92

STACK SAMPLING PARAMETERS

TEST RUN NUMBER 2

MINUTES OF TEST	60
VOLUME OF GAS COLLECTED cubic feet	38.555
METER CALIBRATION FACTOR Y	.99
BAROMETRIC PRESSURE	29.95
PRESSURE DIFFERENTIAL ACROSS ORIFICE DELTA H	1.21
METER TEMPERATURE (+460)	568
STACK STATIC PRESSURE (HG)	.0294
STACK TEMPERATURE (+460)	655
AVERAGE SQUARE ROOT OF VELOCITY HEAD	1.14
VOLUME OF IMPINGER WATER COLLECTED ml	92
WEIGHT OF SILICA COLLECTED gms	5
AREA OF SAMPLING NOZZLE square feet	.0001907
PITOT TUBE COEFFICIENT	.84
AREA OF STACK square feet	9.621
CARBON DIOXIDE (DRY FRACTION)	0
CARBON MONOXIDE (DRY FRACTION)	0
OXYGEN (DRY FRACTION)	21
NITROGEN (DRY FRACTION)	79

STACK PARTICULATE DATA

GAS VOLUME STANDARD CONDITIONS DSCF	35.608
VOLUME OF WATER VAPOR cubic feet	4.569
PERCENT MOISTURE IN STACK GAS	11.4
DRY GAS MOLECULAR WEIGHT	28.84
STACK GAS MOLECULAR WEIGHT	27.604
VELOCITY OF STACK GAS feet per second	72.824
FLOW RATE OF STACK GAS DSCFH	1805032
FLOW RATE OF STACK GAS DSCFM	30084
ISOKINICITY %	99.6
WEIGHT GAIN OF IMPINGERS mg	119.6
WEIGHT GAIN OF FILTER mg	106.4
WEIGHT GAIN OF PROBE WASH mg	47.9
PARTICULATES COLLECTED POUNDS/HOUR	17.23
PARTICULATES COLLECTED GRAINS/DSCF	.0667
PARTICULATES COLLECTED POUNDS/DSCF	9.5456E-06

AFFILIATED ENVIRONMENTAL SERVICES, INC.
3606 VENICE RD.
SANDUSKY, OHIO 44870

PLANT NAME: Verhoff Alfalfa

DATE OF TEST: 9-18-92

STACK SAMPLING PARAMETERS

TEST RUN NUMBER 3

MINUTES OF TEST	60
VOLUME OF GAS COLLECTED cubic feet	38.531
METER CALIBRATION FACTOR Y	.99
BAROMETRIC PRESSURE	29.95
PRESSURE DIFFERENTIAL ACROSS ORIFICE DELTA H	1.2
METER TEMPERATURE (+460)	571
STACK STATIC PRESSURE (HG)	.0294
STACK TEMPERATURE (+460)	655
AVERAGE SQUARE ROOT OF VELOCITY HEAD	1.14
VOLUME OF IMPINGER WATER COLLECTED ml	91
WEIGHT OF SILICA COLLECTED gms	5
AREA OF SAMPLING NOZZLE square feet	.0001907
PITOT TUBE COEFFICIENT	.84
AREA OF STACK square feet	9.621
CARBON DIOXIDE (DRY FRACTION)	0
CARBON MONOXIDE (DRY FRACTION)	0
OXYGEN (DRY FRACTION)	21
NITROGEN (DRY FRACTION)	79

STACK PARTICULATE DATA

GAS VOLUME STANDARD CONDITIONS DSCF	35.398
VOLUME OF WATER VAPOR cubic feet	4.522
PERCENT MOISTURE IN STACK GAS	11.3
DRY GAS MOLECULAR WEIGHT	28.84
STACK GAS MOLECULAR WEIGHT	27.615
VELOCITY OF STACK GAS feet per second	72.809
FLOW RATE OF STACK GAS DSCFH	1806697
FLOW RATE OF STACK GAS DSCFM	30112
ISOKINICITY %	98.9
WEIGHT GAIN OF IMPINGERS mg	124.5
WEIGHT GAIN OF FILTER mg	95.4
WEIGHT GAIN OF PROBE WASH mg	91.7
PARTICULATES COLLECTED POUNDS/HOUR	21.04
PARTICULATES COLLECTED GRAINS/DSCF	.0813
PARTICULATES COLLECTED POUNDS/DSCF	1.16454E-05

~ 3% loss in hammermill

VERHOFF ALFALFA
HOYTVILLE SEPT 18 1992

1 RUN SCALE READING PRODUCT FINISH

START 0 STOP 86 107# A DUMP : 9100# 9202 lbs 4.6 Ton after pellet mill

WET HAY 10 SCOOPS OF HAY
2610# PER SCOOP

SAW DUST 3.5 SCOOP 1300# SCOOP

2 RUN

SCALE START 96 STOP 179 107" A DUMP 8988 lbs 4.49 Tons 4.5 Tons

WET HAY 9.5 SCOOPS 2610 Per Scoop

SAW Dust 3.5 Scoops 1300# PER SCOOP

3 RUN

START 185 STOP 272 102# A Dump 9309 lbs 4.65 tons 4.7 Tons

WET HAY 10 SCOOPS 2610 Per Scoop

SAW Dust 3¾ SCOOPS 1300# Scoop

19

Filename:
Date:
Facility: VerHoff Alfalfa Mills, Inc.
Location: Hoytville, Ohio
Source: Dryer Cyclone Exhaust
Test date: September 18, 1992

Wood-Fired Dryer
Single-Pass

D. Emission Data/Mass Flux Rates/Emission Factors

Test ID	Parameter	Units	Values reported Run 1	Run 2	Run 3	Run 4	AVERAGE
	Stack temperature	Deg F	194	195	195		
	Pressure	in. HG	29.95	29.95	29.95		
	Moisture	%	11.7	11.4	11.3		
	Oxygen	%	21	21	21		
	Volumetric flow, actual	acfm	ND	ND	ND		
	Volumetric flow, standard*	dscfm	30,022	30,084	30,112		
	Isokinetic variation	%	98.9	99.6	98.9		
Circle: Production or feed rate Capacity: Pellet		TPH	4.6	4.5	4.7		
	Pollutant concentrations:						
	Total PM	G/dscf	0.0852	0.1184	0.1354		
	Filterable PM	G/dscf	0.0568	0.0667	0.0813		
	Condensible PM	G/dscf	0.0284	0.0517	0.0541		
	Pollutant mass flux rates:						
	Total PM	lb/hr	21.99	30.59	35.04		
	Filterable PM	lb/hr	14.66	17.23	21.04		
	Condensible PM	lb/hr	7.33	13.36	14.00		
		lb/hr					
		lb/hr					
	Emission factors (ENGLISH UNITS):						AVERAGE
	Total PM	lb/ton	4.78	6.80	7.46		6.35
	Filterable PM	lb/ton	3.19	3.83	4.48		3.83
	Condensible PM	lb/ton	1.59	2.97	2.98		2.51
		lb/ton					
		lb/ton					
	Emission factors (METRIC UNITS):						
	Total PM	kg/Mg	2.39	3.40	3.73		3.17
	Filterable PM	kg/Mg	1.60	1.92	2.24		1.92
	Condensible PM	kg/Mg	0.80	1.49	1.49		1.26
		kg/Mg					
		kg/Mg					

*DSCFM BASED ON A STANDARD TEMPERATURE OF 68 DEGREES FAHRENHEIT

APPENDIX F

EXCERPTS FROM REFERENCE 10

(Toledo Alfalfa Mills, Inc., May 26, 1987)

TOLEDO ALFALFA
COAL FIRED DRYER

EMISSION TEST REPORT
MAY 26, 1987

DATE: June 4, 1987

PROJECT NO.: 03-8069-6254.003

PREPARED BY: Paul D. Sagert
PAUL D. SAGERT
OWENS-ILLINOIS ANALYTICAL SERVICES

1. INTRODUCTION

1.1 PLANT LOCATION

Toledo Alfalfa Mills, Inc.
861 South Stadium Rd.
Oregon, OH 43616

1.2 SOURCE TESTED

Coal Fired Dryer
Ohio EPA Application 0448020004P001
Permit to Install 04-263

Triple-PASS dryer

1.3 TEST DATE

May 26, 1987

1.4 TESTING ORGANIZATION

Owens-Illinois Analytical Services
Environmental Sampling Group
One SeaGate
Toledo, OH 43666
(419) 247-8928

1.5 SAMPLING PERSONNEL

Joseph O. Grau
Paul D. Sagert
Dennis Hiner
Richard Beiswenger

1.6 PURPOSE OF TEST

To document the particulate emissions as requested by Toledo Environmental Services.

1.7 POLLUTANTS MEASURED

Particulate

1.8 REFERENCE METHODS USED

USEPA Method 1 - Determination of sample points and cyclonic flow measurement.
USEPA Method 2 - Flue gas velocity measurements.
USEPA Method 3 - Flue gas molecular weight measurement.
USEPA Method 5 - Determination of particulate emissions.

1.9 OBSERVERS PRESENT

Linda Furlough - Toledo Environmental Services
Jeff Twaddle - Toledo Environmental Services

2. SUMMARY

2.1 EMISSIONS

A summary of the emission results is provided below. Additional information is found in Table 1.

Test No.	2	3	4	AVG.
Particulate (lbs/hr.)	28.8	35.7	34.3	32.9

2.2 PROCESS INFORMATION

A summary of the process data is provided below. The operation was running at capacity considering the moisture content of the alfalfa being processed.

~~15-19~~ 10% pellets (add steam) ~8% moisture

Alfalfa Processed (dry) - 8,780 lbs/hr. — to hammermill
Coal Burned - 1,006 lbs/hr.
4.39 tons

NOTE: Test No. 1 was voided due to sampling error.

alfalfa into plant = 60% moisture

3. PROCESS DESCRIPTION

Toledo Alfalfa Mills dries alfalfa in a coal fired rotary dryer. The control equipment consists of the sulfur dioxide sorbant properties of the alfalfa in the drier and a cyclone for particulate removal.

TABLE 1
TOLEDO ALFALFA MILLS
PROCESS AND PARTICULATE
EMISSION SUMMARY - MAY 26, 1987

A. GENERAL

	2	3	4	AVG
1. Test No.	2	3	4	AVG
2. Avg. Gas Temp (^{0}F)	224	224	224	224
3. Avg. Gas Vel.(FPS)	51.9	51.8	51.7	51.8
4. Avg. Gas Vol.(ACFM)	46,811	46,732	46,659	46,734
(DSCFM)	28,842	28,644	29,309	28,932
5. Isokinetic Sample Rate (%)	91	91	96	

B. EMISSIONS

PARTICULATES				
(gr/DSCF)	0.117	0.146	0.136	0.133
(lbs./hr)	28.8	35.7	34.3	32.9

C. FLUE GAS ANALYSIS

1. Moisture (%)	18.7	17.9	17.2	17.9
2. Oxygen (%)	17.5	17.5	18	17.7
3. Carbon Dioxide (%)	2.5	3.0	2.5	2.7

D. PROCESS DATA

1. Alfalfa Processed (lbs./hr) - 8,780 (dry)
2. Coal Usage (lbs./hr) - 1,006

NOTE: TEST NO. 1 WAS VOIDED DUE TO A SAMPLING ERROR.

Filename:
Date:
Facility: Toledo ALFALFA Mills, Inc.
Location: OREGON, OHIO
Source: DRYER CYCLONE EXHAUST
Test date: MAY 26, 1987

COAL-FIRED DRYER

D. Emission Data/Mass Flux Rates/Emission Factors

Test ID	Parameter	Units	Run 1	Run 2	Run 3	Run 4	AVERAGE
			Values reported				
	Stack temperature	Deg F		224	224	224	
	Pressure	in. HG		29.40	29.40	29.40	
	Moisture	%		18.7	17.9	17.2	
	Oxygen	%		17.5	17.5	18	
	Volumetric flow, actual	acfm		46,811	46,732	46,659	
	Volumetric flow, standard*	dscfm		28,842	28,644	29,309	
	Isokinetic variation	%		91.2	90.8	96.1	
Circle: Production or feed rate Capacity: dried ALFALFA		TPH		4.4	4.4	4.4	
	Pollutant concentrations:						
	FILTERABLE PM	G/dscf	NA	0.117	0.146	0.136	
	Pollutant mass flux rates:						
	FILTERABLE PM	lb/hr		28.8	35.7	34.3	
		lb/hr					
		lb/hr					
		lb/hr					
		lb/hr					
	Emission factors (ENGLISH UNITS):						
	FILTERABLE PM	lb/ton		6.5	8.1	7.8	7.5
		lb/ton					
		lb/ton					
		lb/ton					
		lb/ton					
	Emission factors (METRIC UNITS):						
	FILTERABLE PM	kg/Mg		3.3	4.1	3.9	3.8
		kg/Mg					
		kg/Mg					
		kg/Mg					
		kg/Mg					

*DSCFM BASED ON A STANDARD TEMPERATURE OF 68 DEGREES FAHRENHEIT

APPENDIX G

EXCERPTS FROM REFERENCE 11

(Verhoff Alfalfa Mills, Inc., June 22, 1995)