AP42 Section:	9.12.3
Title:	Letters and Comments

Note: This material is related to a section in *AP42, Compilation of Air Pollutant Emission Factors, Volume I Stationary Point and Area Sources.* AP42 is located on the EPA web site at www.epa.gov/ttn/chief/ap42/

The file name refers to the file number, the AP42 chapter and then the section. The file name "rel01_c01s02.pdf" would mean the file relates to AP42 chapter 1 section 2. The document may be out of date and related to a previous version of the section. The document has been saved for archival and historical purposes. The primary source should always be checked. If current related information is available, it will be posted on the AP42 webpage with the current version of the section.

University City **Science Center**
3624 Market Street, Philadelphia, Pennsylvania 19104, U.S.A.

Industrial Technology and
Energy Management Division
(215) 387-2255
(215) 387-5540 Fax

16 February 1996

Mr. Dallas Safrit
U.S. Environmental Protection Agency
MD 14
Research Triangle Park, NC 27711

Dear Mr. Safrit:

In response to your telephone call yesterday, enclosed is a copy of the assessment report for Environmental Research Brief number EPA/600/S-95/002. The professor who conducted the assessment is Dr. Marvin Fleischman and he can be reached at (502) 852-6357. Dr. Fleischman is a professor at the University of Louisville.

Sincerely,

Gwen P. Looby

Gwen P. Looby
Manager, Technology Applications

encl.

United States
Environmental Protection
Agency
Research and Development

Risk Reduction
Engineering Laboratory
Cincinnati, OH 45268

EPA/600/S-95/002 April 1995

EPA

ENVIRONMENTAL RESEARCH BRIEF

Copy sent to NARI 2-15-96

Waste Minimization Assessment for a Bourbon Distillery

yeast

Marvin Fleischman*, Michael Parris*,
Eric W. Daley**, and Gwen P. Looby

Abstract

The U.S. Environmental Protection Agency (EPA) has funded a pilot project to assist small and medium-size manufacturers who want to minimize their generation of waste but who lack the expertise to do so. Waste Minimization Assessment Centers (WMACs) were established at selected universities and procedures were adapted from the EPA *Waste Minimization Opportunity Assessment Manual* (EPA/625/7-88/003, July 1988). That document has been superseded by the *Facility Pollution Prevention Guide* (EPA/600/R-92/088, May 1992). The WMAC team at the University of Louisville performed an assessment at a plant that manufactures bourbon whiskey and distiller dried grains as a byproduct from corn, rye, and malt. The grains are milled, mixed together, and cooked. Then the resulting mixture is allowed to ferment. After fermentation, the mixture is processed in a distillation column. The distillate is diluted to proper proof and placed in charred barrels for aging. After an appropriate storage period, the barrels are emptied and the contents are shipped in tank trailers. The team's report, detailing findings and recommendations, indicated that large quantities of CO_2 and ethanol are vented from the plant and that significant cost savings could be achieved through CO_2 and ethanol recovery.

This Research Brief was developed by the principal investigators and EPA's Risk Reduction Engineering Laboratory, Cincinnati, OH, to announce key findings of an ongoing research project that is fully documented in a separate report of the same title available from University City Science Center.

* University of Louisville, Department of Chemical Engineering
** University City Science Center, Philadelphia, PA

Introduction

The amount of waste generated by industrial plants has become an increasingly costly problem for manufacturers and an additional stress on the environment. One solution to the problem of waste generation is to reduce or eliminate the waste at its source.

University City Science Center (Philadelphia, PA) has begun a pilot project to assist small and medium-size manufacturers who want to minimize their generation of waste but who lack the in-house expertise to do so. Under agreement with EPA's Risk Reduction Engineering Laboratory, the Science Center has established three WMACs. This assessment was done by engineering faculty and students at the University of Louisville's WMAC. The assessment teams have considerable direct experience with process operations in manufacturing plants and also have the knowledge and skills needed to minimize waste generation.

The waste minimization assessments are done for small and medium-size manufacturers at no out-of-pocket cost to the client. To qualify for the assessment, each client must fall within Standard Industrial Classification Code 20-39, have gross annual sales not exceeding $75 million, employ no more than 500 persons, and lack in-house expertise in waste minimization.

The potential benefits of the pilot project include minimization of the amount of waste generated by manufacturers and reduction of waste treatment and disposal costs for participating plants. In addition, the project provides valuable experience for graduate and undergraduate students who participate in the program, and a cleaner environment without more regulations and higher costs for manufacturers.

Printed on Recycled Paper

Methodology of Assessments

The waste minimization assessments require several site visits to each client served. In general, the WMACs follow the procedures outlined in the EPA *Waste Minimization Opportunity Assessment Manual* (EPA/625/7-88/003, July 1988). The WMAC staff locate the sources of waste in the plant and identify the current disposal or treatment methods and their associated costs. They then identify and analyze a variety of ways to reduce or eliminate the waste. Specific measures to achieve that goal are recommended and the essential supporting technological and economic information is developed. Finally, a confidential report that details the WMAC's findings and recommendations (including cost savings, implementation costs, and payback times) is prepared for each client.

Plant Background

The plant produces bourbon whiskey and distiller dried grains from corn, rye, and malt. It operates three shifts/day to produce approximately 5 million gal of bourbon and over 16,000 tons of distiller dried grain/yr.

Manufacturing Process

The basic raw materials—corn, rye, and malt—are milled in hammer mills and fed to cookers. Water and setback (thin stillage from the drying of spent grain after the alcohol and large solids have been removed) are added and the resulting mixture is cooked. During cooking, the starch in the corn and rye is converted to sugar. After the conversion has taken place, the mixture (known as mash) is pumped to a fermenter where yeast is added to complete the conversion of sugar to alcohol. Upon completion of the fermentation cycle, the mash (or beer) is pumped to an intermediate tank called the beer well.

The contents of the beer well are pumped to the distillation column where the alcohol is steam stripped from the beer. The steam stripper distillate is condensed and pumped to the doubler for final distillation. Distillate from the doubler is condensed and pumped to the barrel-filling operations; spent grain is pumped to the dry house for processing.

At the barrel-filling facility, the distillate is diluted to proper proof with demineralized water. Barrels (of charred new white oak) are filled with the diluted distillate and transported to the warehouse for aging.

During the storage period (a minimum of four years), the material in the barrel goes through a maturation or aging process by which the distillate is transformed into a bourbon. When the product in the barrel is determined to be of proper quality, the barrel is transported to the dumping area. There the contents of the barrel are poured through steel screens for removal of solids. The product is then pumped to one of two storage tanks from which it is loaded into tank trailers for shipment.

Spent grain from the distillation operations is processed into distiller dried grain (an animal feed additive) in the dry house. The spent grain is processed in centrifuges where the solids are concentrated and the excess water (centrate) is removed. The concentrated solids are fed to an air dryer and the centrate is pumped to an evaporator where the dissolved solids are concentrated. The viscous discharge (syrup) from the evaporator is mixed with a portion of the dried grain stream as it is recycled back to the dryer. The portion of the dried grain stream not used as recycle is conveyed to one of two storage silos if the moisture content is satisfactory.

An abbreviated process flow diagram for this plant is shown in Figure 1.

Waste Management Opportunities

The type of waste currently generated by the plant, the source of the waste, the waste management method, the quantity of the waste, and the annual waste management cost for each waste stream identified are given in Table 1.

Table 2 shows the opportunities for waste minimization that the WMAC team recommended for the plant. The minimization opportunity, the type of waste, the possible waste reduction and associated savings, and the implementation cost along with the payback time are given in the table. The quantities of waste currently generated by the plant and possible waste reduction depend on the production level of the plant. All values should be considered in that context.

It should be noted that the economic savings of the minimization opportunity, in most cases, results from the need for less raw material and from reduced present and future costs associated with waste treatment and disposal. Other savings not quantifiable by this study include a wide variety of possible future costs related to changing emissions standards, liability, and employee health. It also should be noted that the savings given for each opportunity reflect the savings achievable when implementing each waste minimization opportunity independently and do not reflect duplication of savings that would result when the opportunities are implemented in a package.

Additional Recommendations

In addition to the opportunities recommended and analyzed by the WMAC team, several additional measures were considered. These measures were not completely analyzed because of insufficient data, minimal savings, implementation difficulty, or a projected lengthy payback. Since one or more of these approaches to waste reduction may, however, increase in attractiveness with changing conditions in the plant, they were brought to the plant's attention for future consideration.

- Seal the grain leaks found throughout the conveying operations.
- Install a shutoff mechanism that provides a tighter seal at the discharge of the milled grain hoppers in order to reduce grain losses.
- Control ethanol emissions from storage tanks.

This research brief summarizes a part of the work done under Cooperative Agreement No. CR-814903 by the University City Science Center under the sponsorship of the U.S. Environmental Protection Agency. The EPA Project Officer was **Emma Lou George**.

Emma 513-569-7578

Gwen Looby
215-387-2255

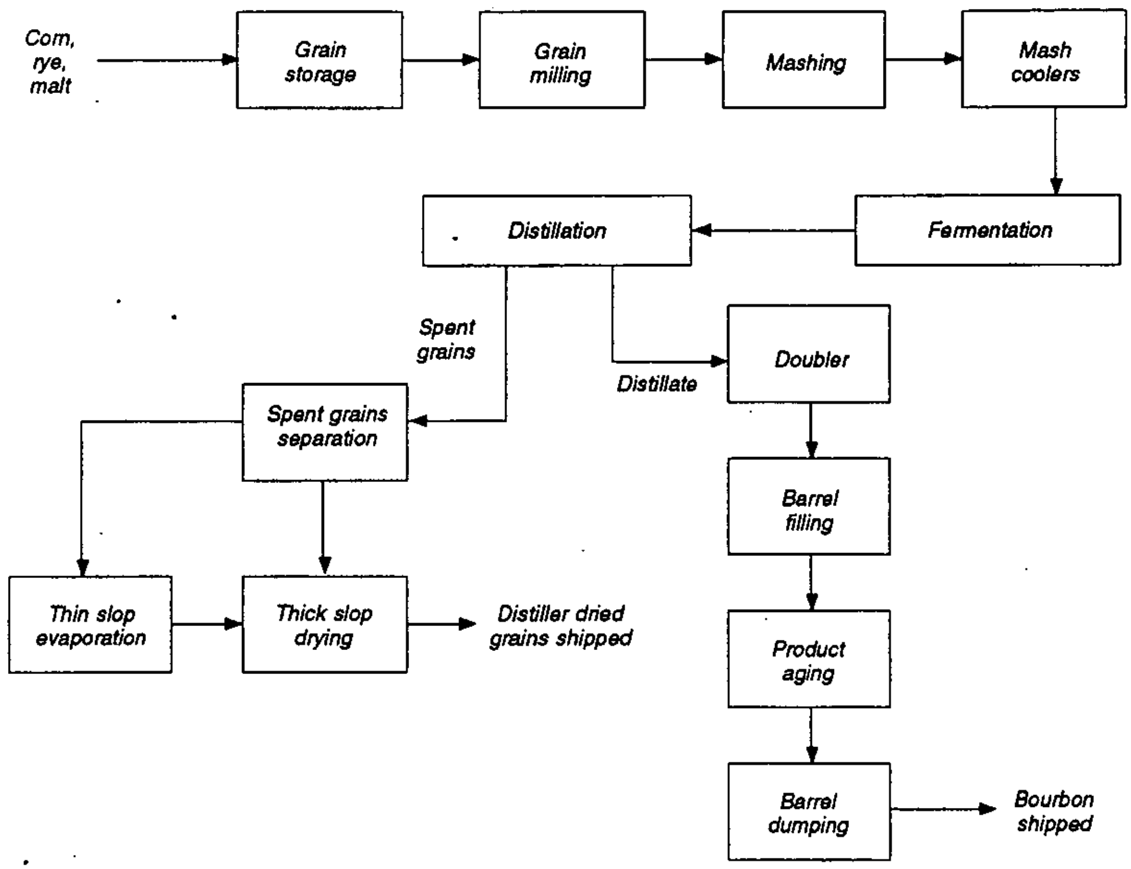

Figure 1. *Abbreviated process flow diagram for bourbon whiskey production.*

Table 1. Summary of Current Waste Generation

Waste Generated	Source of Waste	Waste Management Method	Annual Quantity Generated (lb/yr)	Annual Waste Management Cost[1]
Grain losses	Raw material handling	Shipped offsite to landfill	24,000	$6,000
Carbon dioxide	Fermentation	Vented from plant	25,680,000	0
Ethanol	Fermentation	Vented from plant	205,920	43,680
Wastewater	Fermentation tank cleaning	Treated in onsite WWTP; discharged to creek	846,600	—[2]
Ethanol	Distillation	Vented from plant	228,100	48,000
Spent caustic	Cleaning of distillation equipment	Treated in onsite WWTP; discharged to creek	830,000	—[2]
Spilled ethanol	Barrel filling	Evaporates	1,040	660
Char	Charring of new barrels	Shipped offsite to landfill	480 ft^3/yr	40
Ethanol	Warehoused barrels	Vented from plant	3,181,080	1,020,540
Char/bungs	Emptying of barrels and filtering of contents	Mixed with coal; incinerated in onsite boiler	60,000	0
Filter pads	Filtering of barrel contents	Shipped offsite to landfill	3,200 pads/yr	40
Scrubber solids	Dry house air scrubber	Shipped offsite to landfill	3,000	1,090
Scrubber water	Dry house air scrubber	Treated in onsite WWTP; discharged to creek	149,400	—[2]
Spent caustic	Dry house cleaning	Treated in onsite WWTP; discharged to creek	415,000	—[2]
Slop	Dry house	Sold to farmers	640,000 gal/yr	-7,000 (revenue received)
Distiller dried grain losses	Truck loading, equipment leakage	Shipped offsite to landfill	200,000	17,000
Wastewater	Boiler feedwater treatment	Treated in onsite WWTP; discharged to creek	4,191,500	—[2]
Wastewater	Boiler blowdown	Treated in onsite WWTP; discharged to creek	24,000,000	—[2]
Spent liquids	Demineralizer regeneration	Treated in onsite WWTP; discharged to creek	664,000	—[2]
Ashes	Coal-fired boiler	Shipped offsite to landfill	129,600 ft^3/yr	17,600
Ethanol	Storage tanks	Vented from plant	11,780	5,230
Spent oils	Equipment lubrication	Shipped offsite	275 gal/yr	125
Spent mineral spirits	Parts cleaning	Shipped offsite for recycle	235 gal/yr	1,460
Cloth filters	Dust collectors	Shipped offsite to be cleaned; returned for reuse	110 filters/yr	380

[1] Includes waste treatment, disposal, and handling costs and applicable lost raw materials value.
[2] Cost is included in the annual WWTP operating cost of $118,300/yr.

Table 2. Summary of Recommended Waste Minimization Opportunities

Minimization Opportunity	Waste Reduced	Annual Waste Reduction Quanity (lb/yr)	Annual Waste Reduction Per cent	Net Annual Savings	Implementation Cost	Simple Payback (yr)
Install air ducting from the storage hopper vents to the inlet of an existing pulsating dust collector in order to minimize grain losses from the vent lines.	Grain losses	4,800	20	$1,200	$3,000	2.5
Modify the metal funnel apparatus used during grain unloading from the railcars in order to reduce grain losses.	Grain losses	1,200	5	300	500	1.7
Install a recovery plant to recover CO_2 and ethanol from the fermenters. The recovered liquefied CO_2 can be sold to a distributor or an end-user as a food and beverage grade product. Recovered ethanol can be sold to a fuel alcohol facility or used as supplemental fuel onsite.	Carbon dioxide (from fermentation) Ethanol (from fermentation)	20,160,000 161,700	79 79	223,600[1]	930,000	4.2[2]
Install a refrigerated water-cooled condenser on the vent discharges from the distillation process in order to recover ethanol. Use the recovered ethanol onsite as a supplemental fuel.	Ethanol (from distillation)	228,100	100	19,800	39,000	2.0[2]
Recover ethanol emissions from the barrel warehouse using activated carbon adsorption. Redistill the recovered ethanol and sell the product obtained.	Ethanol (from warehousing)	2,900,000	90	495,380	2,050,000	4.1[2]
Replace the loading apparatus currently used for loading the distiller dried grains with a telescoping loading nozzle in order to reduce grain losses.	Distiller dried grain losses	2,000,000	100	17,000	45,000	2.7

[1] Exact savings may vary from this estimate depending on the exact price obtained for the CO_2.
[2] A much shorter payback will be realized should a carbon emissions tax and/or a VOC emissions tax or permit for ethanol be required in the future.

DISTILLED
SPIRITS
COUNCIL
OF THE
UNITED
STATES

January 5, 1994

Mr. Dallas W. Safriet
Emission Inventory Branch - MD 14
Office of Air Quality Planning and Standards
Environmental Protection Agency
4201 Alexander Drive
Research Triangle Park, NC 27711

Re: EPA Contract No. 68-D2-0159, Work Assignment No. 005 - MRI Project No. 3605 - M(02) - and Draft Revised Chapter for Distilled & Blended Liquor

Dear Mr. Safriet:

On behalf of the Distilled Spirits Council of the United States, Inc. (DISCUS), a national trade association representing producers and marketers of distilled spirits sold in the United States, we appreciate this opportunity to submit comments concerning the Environmental Protection Agency's (EPA) draft report entitled "Emission Factor Documentation for AP-42/Section 6.12.3/Distilled and Blended Liquor" prepared by Midwest Research Institute (MRI). We understand that this draft report has been in the process of preparation for over two years. Upon the receipt of the draft report, we circulated a copy of this document to interested parties in the distilled spirits industry and gathered comments as quickly as possible over the limited time period provided to comment. Consequently, we proffer only our preliminary thoughts, and look forward to the opportunity to work with you to discuss and revise the document.

The proposed MRI AP-42 chapter requires further refinement in order for the report to be to be both useful and accurate. While the draft provides a starting point from which to base discussions, substantially more effort is necessary to characterize properly the industry's production operations. The production of distilled spirits differs significantly from brewing operations, and these differences must be recognized in the draft AP-42 chapter because the corresponding emissions equally are different. Further, different production methods and equipment are utilized across the distilled spirits industry in respective company's operations. Proper characterization of the processes and associated equipment is critical given the potential use of the chapter by federal, state and local air pollution control officials.

DISCUS • 1250 Eye Street, N.W. • Suite 900 • Washington, D.C. 20005-3998 202/628•3544 • FAX: 202/682•8888

In sum, the draft MRI chapter is not adequate to the task of characterizing the industry or, as a result, its emissions. In that regard, there are four major flaws in the draft report:

- First, the draft report inaccurately characterizes and distorts various fundamental aspects of distilled spirits operations. For example, certain sections of the draft report are applicable to brewing operations and have no relevance to distilled spirits operations.

- Second, the draft report when it accurately refers to distilled spirits operations mischaracterizes those operations insofar as not all industry members employ identical techniques and materials. One example where the practices of industry members differ is the various types of aging warehouses utilized by distilled spirits producers.

- Third, when a stage in the distilled spirits operations is accurately described, the type of equipment utilized is mischaracterized and/or the physical and chemical dynamics of the underlying process is misunderstood.

- Fourth, there are numerous inaccuracies and mischaracterizations covering the discussion of barrel soakage in the draft report. For example, the equation used to estimate barrel soakage ignores the physical chemistry involved in the aging process. Further, most, if not all, sound whisky barrels are reused for another 20-30 years, not only for aging Scotch and Irish whiskies, but also Canadian whiskies, wine, rum, aged vinegar, and most all other food product which utilize barrel aging. At the end of their useful life, barrels are burned for energy recovery.

Set forth below are a few examples the mischaracterizations and inaccuracies in the draft report. For your convenience, we have referenced the particular section of the report.

2.2.1 Grain Receiving and Grain Handling (Preparation):

The second sentence needs to be corrected. Distilleries do not do their own malting. It is not economically feasible.

2.2.3 Mashing:

Most distilleries use cold water instead of brine to cool mashes. Mash tubs may either be jacketed or have coils.

Figure 2-1. Whisky Production Process:

The arrow from "fermentation" to "spent grain liquid stillage pressing and drying" illustrates the confusion between the operations of the distillers and those of the brewers. Brewers separate spent grains from wort prior to fermentation. The complete contents of fermenters in a distillery, pass through the still. Distillers do not have wort; they have distiller's beer, usually referred to as just "beer." In Figure 2-1, there should be no spent grains coming from the fermentation area.

2.2.4 Fermentation Stage:

Acetaldehyde, ethyl acetate, fusel oil, and furfural are produced in trace amounts during fermentation. Considering the amounts present, their volatility and ethanol/water solubility characteristics, they are not detectable as emissions under standard fermentation practices. Glycerine generally is not produced.

There is general confusion in this section and throughout the report concerning how MRI defines "open" and "closed" as it applies to vats and tanks. Not all industry members use "open" vats and tanks. Fermentation takes place in either "open" or "closed" vats and tanks depending upon the distiller. Blending discussed in 2.2.8 of the report generally takes place in closed tanks.

To the best of our knowledge, fluorides are not used to control bacterial growth. Good "housekeeping" and good pH control during fermentation accomplishes this function. Lactobacillus, which produces lactic acid, commonly is used for pH control. Sulfuric or phosphoric acid also can be used.

Wort only occurs in breweries. It is inappropriate and misleading when applied to any material associated with a distillery. The process for making "wort" is completely different than that which is used to prepare the mash for "distiller's beer."

2.2.6 Grain and Liquid Stillage Drying:

No spent grains are "recovered from the bottom of fermentation tanks." The entire contents of the fermenter goes into the still.

Screens still are often used to separate the liquid and solid portions of spent grains; but centrifuges are much more common. The liquid portion is concentrated by vacuum evaporation. The resultant syrup is recombined with the solid portion to be dried.

2.2.7 Warehousing/Aging Stage:

Warehouse Type - The second sentence of the third paragraph should read "Distillers may use custom-designed warehouses." Metal clad and wooden houses should be added to stone and brick. In addition, ambient temperature and humidity control are not necessarily a function of warehouse age; each depends on the quality characteristics desired by the particular operations.

Barrel Construction - Many experiments were made in the past on a variety of barrel designs but none that varied from the traditional design were successful. Slight variations in volume and the diameter/length ratio are the only differences in present barrel construction. Further, federal regulation dictates the type of barrel used to age product. For example, charred new oak barrels are required for aging Bourbon whisky.

Product Aging and Quality - The last paragraph in this section contains two misleading statements. It implies that the quality of a product is a direct function of age. This is not true. Product quality is a function of the characteristics of the product originally placed in the barrel, plus the proper balance of changes in flavor due to compounds extracted from the barrel or formed during aging. A product light in original flavor may be overaged, while a product with more original flavor components may be underaged after the same time in a barrel. Maturity is measured by achieving the proper, consistent flavor balance of the product. Brands of whiskies, for example, vary widely, from heavy to light-flavored products; the quality of each brand is determined from the inception of the production process which includes aging as an integral part thereof. Further, it is inaccurate to state that "[s]tronger proof whiskeys take less time to mature because these chemical reactions occur more rapidly."

"Mellowness" of a product has nothing to do with whether it is aged in a "new charred" or a "reused" barrel. Federal regulation and the particular flavor characteristics which the producer desires determine the type of barrel which is used.

In the aging process, both the oak barrel in which beverage alcohol is stored and the barrel environment are key to producing distilled spirits of desired quality and uniqueness. The maturation process gives whisky its characteristic color and distinctive flavor and aroma. Variations in the aging process are integral to producing the characteristic tastes and blends of different products and brands.

Ambient atmospheric conditions, such as temperature and humidity, as well as seasonal variation, are critical factors in the aging process. Aging practices vary considerably -- some distillers, for example, keep their warehouse windows open during certain months to promote interaction of the barrel with outdoor atmospheric conditions. As

EPA observed in its "Cost and Engineering Study - Control of Volatile Organic Emissions from Whiskey Warehousing" (EPA - 450/2-78-013 April 1978), the aging process in particular depends upon the equilibrium interaction of oak barrels with ambient air and particularly the temperature, humidity, and ventilation promoted by the different types of warehouse construction utilized in the industry. While each distiller alters the barrel environment to produce a product with the distinctive characteristics of their brand, the fundamentals of the natural aging process are inviolate.

In producing Bourbon whisky, for example, ethanol from the raw beverage alcohol is unavoidably released because wooden barrels in which it is aged are housed in special open air warehouses for periods of two to eight years or more. The use of oak barrels for aging is not only an industry wide practice, but also is required by federal regulation for the production of whisky. See 27 C.F.R. § 5.22. When whisky ages, the alcohol extracts and reacts with constituents in the barrel wood, producing its distinctive color, taste and aroma. Materials in the wood are transferred to the bulk liquid in the barrel by simple diffusion, by convection currents in the bulk liquid and by temperature cycling. As the barrel heats up, the gas above the liquid increases in pressure and forces liquid into the barrel wood. When the barrel cools and the gas pressure drops, the liquid flows out of the wood into the bulk liquid, carrying wood constituents with it. The distinctive qualities of whisky are added during aging as trace substances called congeners which occur through 1) extraction of organic substances from the wood and their transfer to the whisky, 2) oxidation of the original substances and of the extracted wood material, and 3) reaction between various organic substances present in the liquid to form new products. The amber color develops and the taste of the whisky mellows during aging as the concentration of congeners increases. Ethyl alcohol emissions are a natural and integral consequence of creating the distinctive qualities of Bourbon; the production and aging of which is regulated by federal law. Very similar reactions between the barrel liquid and barrel constituents characterize aging of other distilled spirits as brandy, rum, Scotch, Canadian whisky, and cognac. (It is important to note that water also is emitted during the aging process.)

In aging or maturation, the rate of extraction of wood constituents, transfer and reaction depend upon both ambient conditions such as temperature and humidity and the concentrations of various whisky constituents. For instance, higher temperatures increase the equilibrium rate of extraction, transfer by diffusion, and reaction. Diurnal and seasonal temperature changes also cause convection currents in the liquid and pressure changes in the gas affecting transfer. The rate of diffusion will depend upon the difference of concentrations of constituents in the wood, liquid, and air blanketing the barrel. The rates of reaction will increase or decrease with the concentration of constituents. The equilibrium concentrations of the various whisky components heavily depend upon the air flow around the barrel. All of these variables are utilized by a distiller to produce a consistent, particular product brand which will have its own unique taste, color, and aroma. In fact, EPA has acknowledged in its 1978 Cost and Engineering Study of the industry that, when buildings are closed and ventilation is artificially increased, for instance, the quality of the product could be greatly impaired.

2.2.8 Blending/Bottling:

Pure alcohol, for all practical purposes, never exists. In addition, blending does not take place in open vats or vessels.

2.3 Emissions:

Glycerine is not generated. Further, CO_2 is referred to as an emission. Neither EPA nor the states have authority to regulate CO_2. It is not a "regulated" air pollutant under federal law. With reference to figure 2-1, no PM emissions are generated from spent grain handling as indicated in that flow chart.

2.4 Emissions Control Technology:

The discussion in this section is both inaccurate and misleading. For example, the third sentence states that volatile organic compound emissions from fermenters can be controlled and recovered by carbon absorption systems. There is no factual predicate for this statement. Rather, it is very doubtful that such emissions could be so controlled because of the significant amount of grain solids carried out of the fermenters by air entrainment quickly would render the system inoperable. At present, there are no known control technologies for volatile organic compound emissions from fermenters due to solids entrainment.

Further, the statement that "ethanol emissions from whisky-aging process are reduced by process controls" is misleading. Warehouse construction and the need to maintain natural aging practices are critical to ensuring that there are no changes to product quality. Retrofit process controls on aging warehouses are not practical in light of their potential to adversely affect product quality.

Work practices to eliminate leakage by inspecting barrels is characterized improperly as a "process control." This statement also has the potential to be misleading. Similarly, climate controls are not "process controls" and such systems are not used to minimize and/or regulate changes in humidity and temperature, but to accelerate natural processes. Windows still are opened to cool barrels. In fact, most warehouses are not designed to control or regulate changes in temperature and humidity. Rather, the distiller often takes advantage of naturally occurring environmental conditions.

MRI's statement that "ethanol recovery systems, principally activated carbon systems, have been proposed" is misleading. EPA's 1978 Engineering Study of Whiskey Warehouses, which is cited by the draft report, concluded that "add-on" pollutants controls including carbon adsorption systems, could not be reliably used because of potential adverse impact on product quality. As a result, EPA concluded in 1978 that no CTG was appropriate for aging whisky warehouses. We are not aware of any instance where ethanol emissions control devices have been proposed by officials for aging warehouses.

Section 4:

Equations 4-3 and 4-4 are inaccurate. These equations indicate that soakage continues to be a function of time for the entire aging period. These calculations defy the laws of physical chemistry. Soakage reaches an equilibrium value. There will be minor variations due to changes in ambient air humidity and temperature, and in whisky temperature. This fact would be understood if Fig. 2-2 was more complete. Variables, such as wood density, will cause differences in equilibrium soakage values, but not exposure time. Similarly, equation 4-5 is inaccurate. It would appear that the numerator should be divided by the number of barrels in the warehouse.

Table 4-9 and Section 4.2.2 incorrectly state that bottling and blending emissions are the same as soakage emissions. These are two separate and unrelated events.

The characterization of barrel soakage is incorrect, resulting potentially in a serious overestimation of emissions. For practical purposes, all sound whisky barrels are reused for another 20-30 years, not only in Scotch or Irish whiskies, but also in Canadian whiskies, wine, rum, brandy, aged vinegar, and most other conceivable food products which utilize barrel aging. Barrels are burned as fuel after their useful life. They also are frequently shipped off site within hours of dumping. DISCUS knows of no instances where they are vacuumed.

Conclusion

DISCUS submits that significant, additional work is required to correct the inaccuracies and deficiencies of MRI's draft report. As stated previously, the comments offered above are not inclusive, but merely are illustrative of the flaws in the draft report. For example, MRI's discussion in section 2.1 "Industry Characterization" does not depict or describe the industry accurately. The number of distillers, the volume of sales and related information require revision.

The fundamental errors in the contractor's discussion of the processes for producing distilled spirits are basic problems that must be resolved before this draft report is finalized. DISCUS looks forward to assisting EPA in this effort.

If you have any questions concerning the above, please do not hesitate to call me.

Sincerely,

Lynne J. Omlie
General Counsel

LJO:bca

DISTILLED
SPIRITS
COUNCIL
OF THE
UNITED
STATES

February 15, 1995

Mr. Dallas W. Safriet
Emissions Inventory Branch - MD 14
Office of Air Quality Planning and Standards
Environmental Protection Agency
4201 Alexander Drive
Research Triangle Park, NC 27711

Re: EPA Contract No. 68-D2-0159, Work Assignment No. II-03 - MRI Project No. 4602-03: "Emission Factor Documentation for AP-42/Section 9.12.3/Distilled and Blended Liquors -- Revised Draft Report"

Dear Mr. Safriet:

On behalf of the Distilled Spirits Council of the United States, Inc. (DISCUS), a national trade association representing producers and marketers of distilled spirits sold in the United States, we appreciate the opportunity to review and comment upon the Environmental Protection Agency's (EPA) revised draft report concerning emission factor documentation for the distilled spirits industry prepared by Midwest Research Institute (MRI). As you know, we provided detailed comments in January 1994 concerning MRI's first draft of this AP-42 chapter, which were forwarded to EPA to assist in revising the chapter.

Upon receipt of the revised draft, we again undertook to circulate the document to industry members for review and analysis to assist you in finalizing this AP-42 chapter. The consensus among industry members is that the revised draft of the MRI report still cannot be accepted by EPA. Although improved from the initial draft, the revised draft report requires further refinement in order for this document to be both useful and accurate. In that regard, substantially more effort is necessary to characterize properly the industry's production operations.

Proper characterization of the processes and associated equipment is critical given the potential use of the chapter by federal, state and local air pollution control officials. The fundamental errors in the contractor's discussion of the processes for producing distilled spirits are basic problems that must be resolved before this draft report is finalized. In sum, the draft MRI chapter is not adequate to the task of characterizing the industry or, as a result, its emissions.

DISCUS • 1250 Eye Street, N.W. • Suite 900 • Washington, D.C. 20005-3998 202/628•3544 • FAX: 202/682•8888

In light of the significant, additional work required to correct the draft report, we believe that the most productive next step would be to meet with your staff to review the report at a detailed level. To that end, we are prepared to organize such a meeting at any time and location convenient to you. I will contact you concerning this proposal, and underscore again that DISCUS looks forward to assisting EPA in this effort.

Sincerely,

Lynne J. Omlie
General Counsel

LJO:bca

DISTILLED
SPIRITS
COUNCIL
OF THE
UNITED
STATES

August 25, 1995

Mr. Dallas W. Safriet
Emissions Inventory Branch - MD 14
Office of Air Quality Planning and Standards
Environmental Protection Agency
4201 Alexander Drive
Research Triangle Park, NC 27711

Dear Mr. Safriet:

On behalf of the Distilled Spirits Council of the United States, Inc., I want to express our gratitude for the opportunity to meet with you and Mr. Lapp to discuss the draft AP-42 chapter concerning distilled spirits. You provided us with invaluable insight and information not only about the development of AP-42 chapters generally, but also about the specific chapter concerning distilled spirits.

You have a herculean task in preparing EPA's AP-42 chapters for the myriad of American industries subject to your mandate. This endeavor must be even more daunting without the opportunity to visit, and thus acquaint yourself with, the production sites of the industry discussed in your AP-42 chapter. In that regard, one of the major purposes of our meeting was to "bring" the distilled spirits industry to you.

We hope our visit with you was as productive for you as it was for us. We look forward to continuing to work with you in the Agency's finalization of the AP-42 chapter for distilled spirits.

Thank you again for taking time out of your busy schedule to meet with us.

Sincerely,

Lynne J. Omlie
General Counsel

LJO:clc

DISTILLED
SPIRITS
COUNCIL
OF THE
UNITED
STATES

TELECOPIER TRANSMITTAL FORM

TIME: ______________________

DATE: **September 22, 1995**

ATTENTION: Thomas W. Lapp, Ph.D.

Midwest Research Institute

TELECOPIER #: 919/677-0065

FROM: Lynne J. Omlie

DISCUS

We are transmitting 18 pages (including this cover page). If there is a problem with this transmission, please call (202) 628-3544 and ask for Bridget Allshouse.

DISCUS • 1250 Eye Street, N.W. • Suite 900
Washington, D.C. 20005-3998
202/628•3544 • FAX: 202/682•8888

DISTILLED
SPIRITS
COUNCIL
OF THE
UNITED
STATES

September 22, 1995

Thomas W. Lapp, Ph.D.
Principal Environmental Scientist
Midwest Research Institute
401 Harrison Oaks Boulevard
Suite 350
Cary, North Carolina 27513-2412

Dear Dr. Lapp: Tom

Thank you for the opportunity to provide comments concerning the draft AP-42 Chapter for brandy. To that end, please find enclosed a copy of our comments.

On behalf of DISCUS, I again want to express our appreciation for meeting with us last month. The meeting was both productive and informative, and we look forward to working with you as the Agency finalizes the AP-42 Chapter pertaining to the distilled spirits industry.

Sincerely,

Lynne J. Omlie
General Counsel

LJO:bca

Enclosure

DISCUS • 1250 Eye Street, N.W. • Suite 900 • Washington, D.C. 20005-3998 202/628-3544 • FAX: 202/682-8888

Emission Factor Documentation for AP-42
Section 9.12.2

Wines and Brandy

Draft 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. II-03

MRI Project No. 4602-03

July 1995

and pomace, heating, adding SO_2, and using highly pigmented varieties of grapes. Port can be produced by baking, but with a shorter baking time than baked sherries.

When the fermenting must is run off (separated from the pomace by gravity), it is fortified with wine spirits containing about 77 percent alcohol. The first press fraction for red port is fortified to the same level as the free-run and may be kept separate for independent aging or blended with the free-run. Most white ports are fortified when half the original sugar content has been fermented. However, semidry and dry white ports are fortified later in the process.

The type and duration of aging depend on the style of wine desired. Slight fortification after each racking compensates for alcohol evaporation from the cooperage, and blending is used to achieve the desired properties of the wine. The final blend is left to mature in oak cooperage for several months prior to fining, filtration, stabilization, and bottling.

2.2.5 Brandy Production

Brandy is an alcoholic distillate or mixture of distillates obtained from the fermented juice, mash, or wine of grapes or other fruit (e.g., apples, apricots, peaches, blackberries, or boysenberries). Brandy is produced at less than 190° proof and bottled at a minimum 80° proof. (In the United States, "proof" means the ethyl alcohol content of a liquid at 60°F, stated as twice the percent ethyl alcohol by volume.) Two types of spirits are produced from wine or wine residue: beverage brandy and "wine spirits." Beverage brandy is distilled at 170° proof or lower from the fermented juice or mash of whole fruit, reduced to 102° to 130° proof for aging, and further reduced to 80° to 100° proof for bottling. Wine spirits include all spirits eligible for addition to wines: neutral spirits (190° or more proof), neutral brandy (171° to 189° proof), and brandy (140° to 170° proof).

OR OTHER FRUIT (WHAT IS USED INSTEAD ?)

In brandy production, the grapes are pressed immediately after crushing. There are two major differences in the fermentation process between wine and brandy production. Pure yeast cultures are not used in the fermentation process for brandy. For brandy, the fermentation process is not temperature controlled as it is in wine production. Brandy can be made solely from the fermentation of fruit or can be distilled from the lees leftover from the racking process in still wine production or the pomace cap that is leftover from red still wine fermentations.

DRAFT
3869/460203
7/25/95

GENERALLY

SPIRITS

Distillation starts immediately after the fermentation and continues until all newly fermented wine is distilled. Nearly all U.S. producers use continuous column distillation, usually with an aldehyde section, instead of pot stills. For a detailed discussion of the distillation and aging of distilled ~~liquors~~, which include brandy and brandy spirits, refer to AP-42 Section 9.12.3, Distilled and Blended ~~Liquors~~.

SPIRITS

After distillation, the brandy is aged in oak casks. Aging time can vary from 3 to 15 years or more. During aging, some of the brandy seeps through the oak and evaporates, so brandy ~~and caramel coloring are~~ IS added periodically to compensate for this loss. ~~The addition of the~~ caramel coloring ~~gives~~ the brandy a characteristic dark brown color. After aging, the brandy may be BLENDED, flavored, and then chilled, filtered, and bottled.

MAY ALSO BE ADDED DURING AGING TO GIVE

2.3 EMISSIONS[5,7-8]

Ethanol is the primary volatile organic compound (VOC) emitted during the production of wines and brandy. Acetaldehyde, methane, n-propyl alcohol, n-butyl alcohol, sec-butyl alcohol, isobutyl alcohol, and isoamyl alcohol are also generated and emitted but in much smaller quantities compared to ethanol. In addition, a large number of other compounds are formed during the fermentation and aging process. It is the presence of these compounds that gives wines and brandy the complex aroma and flavor.

SMALL AMOUNTS OF ARE AS A PRESERVATIVE

Prior to the fermentation, liquified sulfur dioxide (SO_2) ~~is~~ often added to the grapes after harvest and to the juice or must; SO_2 emissions can occur during these steps. Except for these potential emissions, there is little potential for emissions prior to the fermentation step in wine production.

During fermentation, large volumes of CO_2 are produced from the yeast metabolism of the sugars present in the juice or must; a general CO_2 production rate of approximately 260 milliliters per gram (ml/g) of glucose or fructose has been cited. This represents a volume greater than 50 times the volume of juice fermented. The escape of CO_2 is estimated to remove about 20 percent of the heat generated during fermentation. Ethanol loss was previously believed to occur through entrainment of the liquid droplet in the escaping CO_2 but recent studies indicate that evaporation is the major mechanism for ethanol loss. Ethanol droplets are formed and leave the must surface but

? REMAINDER OF TEXT

5. PROPOSED AP-42 SECTION

The proposed AP-42, Section 9.12.2, Wines and Brandy, is presented on the following pages as it would appear in the document.

DRAFT

9.12.2 WINES AND BRANDY

9.12.2.1 General

.7 .14 ,24

Wine is an alcoholic beverage produced by the fermentation of sugars in fruit juices, primarily grape juice. In general, wines are classified into two types based on alcohol content: table wines (~~8~~ percent to 14 percent, by volume) and fortified wines (~~17~~ percent to ~~22~~ percent, by volume). Table wines are further subdivided into still and sparkling categories, depending upon the carbon dioxide (CO_2) content retained in the bottled wine. Still table wines are divided into three groups: red, rosé (or blush), and white based on the color of the wine.

9.12.2.2 Process Description[1-4]

The production of still table wines is discussed in the following paragraphs, followed by more concise discussions of the production of sweet table wines, sparkling wines, fortified wines, and brandy.

, AG...

Still Table Wines — The basic steps in vinification (wine production) include harvesting, crushing, pressing, fermentation, clarification, finishing, and bottling. A simplified process diagram outlining the basic steps in the production of still table wines is shown in Figure 9.12.2-1.

Harvesting of grapes is usually conducted during the cooler periods of the day to prevent or retard heat buildup and flavor deterioration in the grape. Most wineries transport the whole grapes but some crush the grapes in the vineyard and transport the crushed fruit to the winery. Stemming and crushing are commonly conducted as soon as possible after harvest. These two steps are currently done separately using a crusher-stemmer, which contains an outer perforated cylinder to allow the grapes to pass through but prevents the passage of stems, leaves, and stalks. Crushing the grapes after stemming is accomplished by any one of many procedures; the three processes generally favored are: (1) pressing grapes against a perforated wall; (2) passing grapes through a set of rollers; or (3) using centrifugal force. From 75 to 150 milligrams per liter (mg/L) of liquified sulfur dioxide (SO_2) is added to the crushed grape mass to control wild yeast contamination and spoilage bacteria.

DRAFT

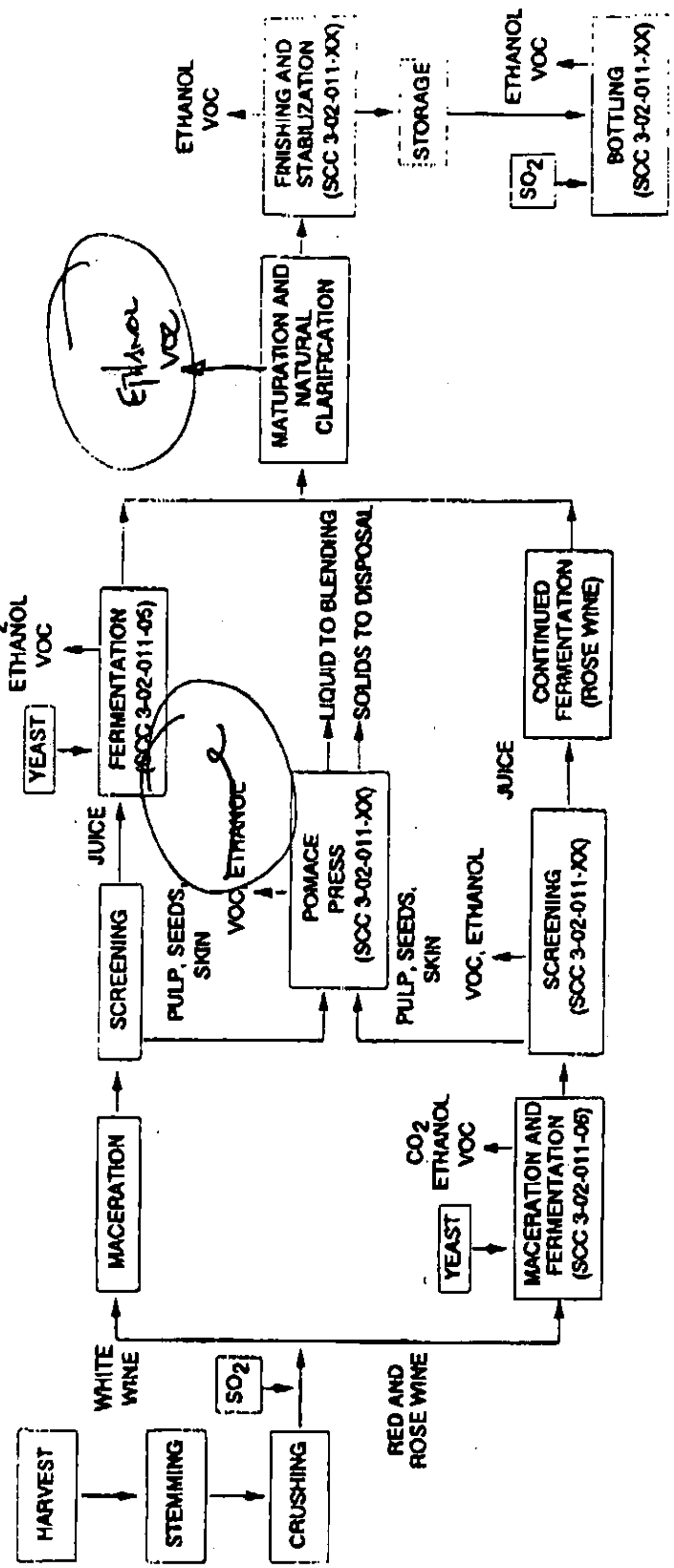

Figure 912.2.-1. Basic steps in still table wine production.
(Source Classification Codes in parentheses.)

DRAFT

Maceration is the breakdown of grape solids following crushing of the grapes In red and rosé wine production, the slurry of juice, skins, seeds, and pulp is termed the "must." In white wine production, the skins, seeds, and pulp are separated from the juice before inoculation with yeast and only the juice is fermented. A fermenting batch of juice is also called "must". Thus, the term "must" can refer to either the mixture of juice, seeds, skins, and pulp for red or rosé wines or only the juice for white wines. Maceration is always involved in the initial phase of red wine fermentation. If the volume of must is small, the juice is extracted from the must in a press. However, for large volumes of must, gravity flow dejuicers are often used to initially separate the majority of the juice from the crushed grapes and the press used to extract the juice remaining in the mass of pulp, skins, and seeds (pomace). There are many designs of dejuicers but, generally, they consist of a tank fitted with a perforated basket at the exit end. After gravity dejuicing has occurred, the pomace is placed in a press and the remaining juice extracted. There are three major types of presses. The horizonal press is used for either crushed or uncrushed grapes. A pneumatic press can be used for either crushed or uncrushed grapes as well as for fermented must. The continuous screw press is the only one that operates uninterrupted and works best with fermented must but can be adjusted for crushed, nonpulpy grapes. After pressing, white must is typically clarified prior to fermentation to retain the fruity character. The white juice is commonly allowed to settle for up to 12 hours but may be centrifuged to speed the clarification.

AND/OR FILTERED

Fermentation is the process whereby the sugars (glucose and fructose) present in the must undergo reaction by yeast activity to form ethyl alcohol (ethanol) and CO_2 according to the equation:

$$C_6H_{12} \rightarrow 2\ C_2H_5OH + 2\ CO_2$$

In the U. S., the sugar content of the juice is commonly measured with a hydrometer in units of degree Brix (°B), which is grams (g) of sugar per 100 grams of liquid. Fermentation is initiated by the addition of yeast inoculation to the must. The fermentation process takes place in tanks and vats of a wide variety of shapes, sizes, and technical designs. Tanks are different from vats in that tanks are enclosed, whereas vats have open tops. In most of the larger wineries, tanks have almost completely replaced vats. Since the 1950s, the move has been away from the use of wooden tanks to primarily stainless steel tanks; lined concrete tanks are also used and fiberglass tanks are becoming more popular due to their light weight and lower cost.

The fermentation process is an exothermic reaction and requires temperature control of the fermenting must. Red wines are typically fermented at 25° to 28°C (70° to 82°F) and white wines at

DRAFT

8° to 15°C (46° to 59°F). Almost all of the fermentation is conducted by the batch process, continuous fermentors are rarely used in the U. S. Size of the fermentors is based primarily on the volume of juice or must to be fermented. During fermentation of red wines, the CO_2 released by the yeast metabolism becomes entrapped in the pomace (layer of skins and seeds) and causes it to rise to the top of the tank where it forms a cap. The pomace cap is periodically covered with the must to increase color removal, aerate the fermenting must, limit growth of spoilage organisms in the cap, and help equalize the temperature in the fermenting must. For white wines, the main technical requirement is efficient temperature control. Temperature is one of the most influential factors affecting the fermentation process. During fermentation of both white and red must, the CO_2, water vapor, and ethanol are released through a vent in the top of the tank. Malolactic fermentation sometimes follows the primary fermentation and results in a reduction in the acidity of the fermented juice or must. There are very diverse opinions about this step because the fermentation, to varying degrees, can improve or reduce wine quality.

After fermentation, all wines undergo a period of adjustment (maturation) and clarification prior to bottling. The process of maturation involves the precipitation of particulate and colloidal material from the wine as well as a complex range of physical, chemical, and biological changes that tend to maintain and/or improve the sensory characteristics of the wine. The major adjustments are acidity modification, sweetening, dealcoholization, color adjustment, and blending. Following the fermentation process, a preliminary clarification step is commonly accomplished by decanting the wine from one vessel to another, called racking, in order to separate the sediment (lees) from the wine. Current racking practices range from manually decanting wine from barrel to barrel to highly sophisticated, automated, tank-to-tank transfers. In all cases, separation occurs with minimal agitation to avoid resuspending the particulate matter. The residue from racking may be filtered to recover wine otherwise lost with the lees or used "as is" for brandy production.

AGING IS MUCH MORE COMPLEX THAN JUST "STABILIZATION & CLARIFICATION"

Stabilization and further clarification steps follow maturation and initial clarification to produce a permanently clear wine with no flavor faults. The steps entail various stabilization procedures, additional clarification (fining), and a final filtration prior to bottling. The most common stabilization technique used for many red wines and some white wines is aging the wine for a period of months or years. Vessels used to store and age wine, termed cooperage, are produced in a wide range of sizes, depending on their intended use. White oak has traditionally been used for the barrels to age wine, but currently its usage is reserved primarily for the production of premium white and red wines and some fortified wines. Water and ethanol are lost through the barrel surfaces and a partial vacuum develops in the space created by this loss. Each barrel is periodically opened and topped off

DRAFT

with wine to fill the void created by the ethanol and water loss. Cooperage constructed from materials other than wood has many advantages and is less expensive to maintain. Stainless steel is often preferred, but fiberglass and concrete are also used. In addition to aging, other stabilization procedures are used to prevent formation of potassium bitartrate or calcium tartrate crystals, haziness (casse) resulting from protein coalescence, casse resulting from oxidation of tannins present in the wine, and haziness due to metal ions, such as iron and copper. Enzyme mixtures are used to remove polysaccharides which can cause filtration problems and haze formation. Most wines contain viable but dormant microorganisms. Racking is used as an initial step in microbial stabilization but long-term stability frequently requires use of sulfur dioxide as the antimicrobial agent. Other methods include pasteurization and filter sterilization. Sulfur dioxide may be added at various stages in wine production to prevent microbial growth but it is always added after fermentation. Finishing (fining) agents are commonly added to accelerate the spontaneous precipitation of suspended material in wine. Prior to bottling, a final clarification step is used to remove any remaining suspended material in the wine. This step involves only physical methods of clarification and generally consists of a filtration procedure.

such as weight and breakage

Glass bottles are the container of choice for premium quality wines and for sparkling wines. Due to some disadvantages, glass bottles are sometimes being replaced by new containers, such as bag-in-box, for many standard quality, high volume wines. To protect the wine against microbial spoilage, and to limit oxidation, the wine is adjusted to a final level of 50 mg/L of SO_2 before filling. Precaution is taken to minimize contact with air during filling and thereby reduce oxidation. This is done by flushing the bottle with CO_2 before filling or flushing the headspace with CO_2 after filling.

or nitrogen or nitrogen

Sweet Table Wines — The most famous of the sweet wines are those made from noble-rotted, *Botrytis*-infected grapes. These wines are produced to a limited extent in the United States. The *Botrytis* mold acts to loosen the grape's skin so moisture loss occurs rapidly and the sugar concentration increases in the grape. The grapes are then selectively picked, followed by pressing, and fermentation. Fermentation is a slow process, however, because of the high sugar content and the use of SO_2 to retard the growth of undesirable molds and microorganisms. Non-botrytized sweet wines are also produced by drying the grapes. Drying involves allowing the grapes to dehydrate on mats or trays in the shade for weeks or months and then crushing the grapes and fermenting the concentrated juice. Heating, boiling, or freezing is also used to concentrate juice for semisweet wines.

DRAFT

Sparkling Wines — Most sparkling wines obtain CO_2 supersaturation using a second alcoholic fermentation, typically induced by adding yeast and sugar to dry white wine. There are three principal methods of sparkling wine production: the traditional method, the transfer method, and the bulk method. In the traditional method, both red and white grapes may be used, but most sparkling wines are white. The grapes are harvested earlier than those used for still table wines and pressed whole without prior stemming or crushing to extract the juice with a minimum of pigment and tannin ~~extraction; this is important for producing~~ white sparkling wines from red-skinned grapes. Primary fermentation is carried out at approximately 15°C (59°F) and bentonite and/or casein may be added to aid the process. The blending of wines produced from different sites, varieties, and vintages distinguishes the traditional method. Before preparing the blend (*cuvée*), the individual base wines are clarified and stabilized. Aging typically takes place in stainless steel tanks but occasionally takes place in oak cooperage. The secondary fermentation requires inoculation of the *cuvée* wine with a special yeast strain. A concentrated sucrose solution is added to the *cuvée* just prior to the yeast inoculation. The wine is then bottled, capped, and stacked horizontally at a stable temperature, preferably between 10° to 15°C (50° to 59°F), for the second fermentation. After fermentation, the bottles are transferred to a new site for maturation and stored at about 10°C (50°F).

NOT TO 5.0 IN FERMENTATION NEED TO IMPROVE CLARITY.

, OR TWO

Riddling is the technique used to remove the yeast sediment (lees). The process involves loosening and suspending the cells by manual or mechanical shaking and turning, and positioning the bottle to move the lees toward the neck. Disgorging takes place about a year after bottling. The bottles are cooled and the necks immersed in an ice/$CaCl_2$ or ice/glycol solution to freeze the sediment. The disgorging machine rapidly removes the cap on the bottle, allowing for ejection of the frozen yeast plug. The mouth of the bottle is quickly covered and the fluid level is adjusted. Small quantities of SO_2 or ascorbic acid may be added to prevent subsequent in-bottle fermentation and limit oxidation. Once the volume adjustment and other additions are complete, the bottles are sealed with special corks, the wire hood added, and the bottles agitated to disperse the additions. The bottles are then decorated with their capsule and labels and stored for about 3 months to allow the corks to set in the necks. The transfer method is identical to the traditional method up to the riddling stage. During aging, the bottles are stored neck down. When the aging process is complete, the bottles are chilled below 0°C (32°F) before discharge into a transfer machine and passage to pressurized receiving tanks. The wine is usually sweetened, sulfited, clarified by filtration, and sterile filtered just before bottling.

In the bulk method, fermentation of the juice for the base wine may proceed until all the sugar is consumed or it may be prematurely terminated to retain sugars for the second fermentation.

DRAFT

The yeast is removed by centrifugation and/or filtration. Once the *cuvée* is formulated, the wines are combined with yeast additives and, if necessary, sugar. The second fermentation takes place in stainless steel tanks similar to those used in the transfer process. Removal of the lees takes place at the end of the second fermentation by centrifugation and/or filtration. The sugar and SO_2 contents are adjusted just before sterile filtration and bottling.

Other methods of production of sparkling wine include the "rural" method and carbonation. The rural method involves prematurely terminating the primary fermentation prior to a second in-bottle fermentation. The injection of CO_2 (carbonation) under pressure at low temperatures is the least expensive and the least prestigious method of producing sparkling wines.

Fortified Wines — Fortified wines are classified together because of their elevated alcohol content. The most common fortified wines are sherries and ports.

Baking is the most popular technique for producing sherries in the United States. Grapes are crushed and stemmed and SO_2 added as soon as possible to control bacteria and oxidation. The maximum amount of juice is separated from the skins and the juice is transferred to fermentors. The juice is inoculated with starter and fermented at temperatures of 25° to 30°C (77° to 86°F). The new wine is then pumped from the fermentor or settling tank to the fortification tank. High proof spirits are added to the sherry material, or shermat, to raise the alcohol content to 17 to 18 percent by volume and then the wine is thoroughly mixed, clarified, and filtered before baking. Slow baking occurs when the wine is stored in barrels exposed to the sun. More rapid baking is achieved through the use of artificially heated storage rooms or heating coils in barrels or tanks. After baking, the sherry is cooled, clarified, and filtered. Maturation is then required and is usually carried out in oak barrels; aging can last from 6 months to 3 years or MORE .

Port wines are produced by the premature termination of fermentation by addition of brandy. When the fermenting must is separated from the pomace by gravity, it is fortified with wine spirits containing about 77 percent alcohol. Most white ports are fortified when half the original sugar content has been fermented, except for semidry and dry white ports which are fortified later. The type and duration of aging depend on the desired style of wine. Blending is used to achieve the desired properties of the wine. The final blend is left to mature in oak cooperage for several months prior to fining, filtration, stabilization, and bottling

BY VOLUME.

DRAFT

Brandy Production — Brandy is an alcoholic distillate or mixture of distillates obtained from the fermented juice, mash, or wine from grapes or other fruit (e. g., apples, apricots, peaches, blackberries, or boysenberries). Brandy is produced at less than 190° proof and bottled at a minimum of 80° proof. (In the United States, "proof" denotes the ethyl alcohol content of a liquid at 15.6°C (60°F), stated as twice the percent ethyl alcohol by volume.) Two types of spirits are produced from wine or wine residue: beverage brandy and "wine spirits". (WHAT IS USED INSTEAD?)

In brandy production, the grapes are pressed immediately after crushing. There are two major differences in the fermentation process between wine and brandy production. Pure yeast cultures are not used in the fermentation process for brandy SPIRITS IN THE UNITED STATES. For brandy production, the fermentation process is not temperature controlled as it is in wine production. Brandy can be made solely from the fermentation of fruit or can be distilled from the lees leftover from the racking process in still wine production or from the pomace cap that is leftover from still red wine fermentations.

Distillation is commenced immediately after the fermentation step GENERALLY using continuous column distillation, usually with an aldehyde section, instead of pot stills. For a detailed discussion of the distillation and aging of distilled ~~liquors~~ SPIRITS, which include brandy and brandy spirits, refer to AP-42 Section 9.12.3, "Distilled and Blended SPIRITS ~~Liquors~~". After distillation, the brandy is aged in oak casks for 3 to 15 years or more. During aging, some of the ethanol and water seeps through the oak and evaporates, so brandy ~~and caramel coloring are~~ IS added periodically to compensate for this loss. The ~~addition of the~~ caramel coloring ~~gives~~ IS ALSO ADDED TO GIVE the brandy a characteristic dark brown color. After aging, the brandy may be flavored, and then chilled, filtered, and bottled.

9.12.2.3 Emissions And Controls[5-11]

Ethanol AND CO_2 are ~~is~~ the primary compounds emitted ~~emissions generated~~ ~~pollutant emitted~~ during the fermentation step in the production of wines and brandy. Acetaldehyde, methyl alcohol (methanol), n-propyl alcohol, n-butyl alcohol, sec-butyl alcohol, isobutyl alcohol, and isoamyl alcohol also are emitted but in much smaller quantities compared to ethanol emissions. In addition, a large number of other compounds are formed during the fermentation and aging process. Selected examples of other types of compounds formed and potentially emitted during the fermentation process include a variety of acetates, monoterpenes, higher alcohols, higher acids, aldehydes and ketones, organosulfides, and hydrogen sulfide. During the fermentation step, large quantities of CO_2 are also formed and emitted.

DRAFT

SMALL AMOUNTS OF

Fugitive ethanol emissions also occur during the screening of the red wine, pressing of the pomace cap, aging in oak cooperage, and the bottling process. In addition, liquified SO_2 ~~is~~ ARE often added to the grapes after harvest, to the must prior to fermentation, or to the wine after the fermentation is completed; SO_2 emissions can occur during these steps. There is little potential for VOC emissions before the fermentation step in wine production.

AS A PRESERVATIVE

MINOR PM FROM DE-STEM. HANDLING OF POMACE, ETC. ?

Except for harvesting the grapes and possibly unloading the grapes at the winery, there are essentially no potential for particulate (PM) emissions from this industry.

Emission controls are not currently used during the production of wines or brandy. Five potential control systems have been considered and three have been the subject of pilot-scale emission test studies at wineries or universities in California. The five systems were: (1) carbon adsorption, (2) water scrubbers, (3) catalytic incineration, (4) condensation, and (5) temperature control. All of the systems have disadvantages either in terms of low control efficiency, cost effectiveness, or overall applicability to the wide variety of wineries.

Emission factors for VOC emissions from the fermentation step in wine production are shown in Tables 9.12.2-1 (Metric units) and -2 (English units). The emission factors for controlled ethanol emissions and the uncontrolled emissions of other VOC from the fermentation step should be used with extreme caution because the factors are based on a very small number of tests and fermentation conditions vary considerably from one winery to another.

The only emission factors for wine production processes other than fermentation, were obtained from a 1982 test (Reference 7). These factors represent uncontrolled fugitive ethanol emissions during handling processes. The factor for fugitive emissions from the drag screen for red wine (SCC 3-02-011-XX) is 6.0 g/hl of juice (0.5 lb/1,000 gal). An ethanol emission factor for the pomace press is applicable only to red wine because the juice for white wine goes through the pomace press before the fermentation step. The emission factor for red wine (SCC 3-02-011-XX) is 9.1 g/907.2 kg of pomace (0.02 lb/ton). Although fugitive emissions occur during the bottling of both red and white wines, an emission factor is available only for the bottling of white wine. The factor for white wine (SCC 3-02-011-XX) is 1.2 g/hl of wine (0.1 lb/1,000 gal). All of these factors are rated E. These emission factors should be used with extreme caution because they are based on a limited number of tests conducted at one winery.

DRAFT

Draft Table 9.12.2-1 (Metric Units).
VOC EMISSION FACTORS FOR WINE FERMENTATION[a]

EMISSION FACTOR RATING: E

Wine type	Type of control	Ethyl alcohol, g/hl[b]	Methyl alcohol, g/hl	n-Propyl alcohol, g/hl	n-Butyl alcohol, g/hl	Sec-Butyl alcohol, g/hl	Isobutyl alcohol, g/hl	Isoamyl alcohol, g/hl	Acetaldehyde, g/hl
Red	None[c]	55	0.030	0.041	6.6E-4	5.4E-6	0.043	0.17	0.032
(SCC 3-02-011-06)	Carbon adsorption[d]	2.0	ND	ND	ND	ND	ND	ND	ND
	Catalytic incineration[e]	13	ND	ND	ND	ND	ND	ND	ND
	Wet scrubber[e]	0.67	ND	ND	ND	ND	ND	ND	ND
White	None[c]	22	0.0077	0.028	ND	ND	0.0083	0.061	0.0086
(SCC 3-02-011-05)	Carbon adsorption[d]	1.1	ND	ND	ND	ND	ND	ND	ND
	Catalytic incineration[e]	1.8	ND	ND	ND	ND	ND	ND	ND
	Wet scrubber[e]	0.99	ND	ND	ND	ND	ND	ND	ND

[a]Emission factor units are g/hl of fermented juice produced. SCC = Source Classification Code. ND = no data.
[b]11.98 g/hl = 1 lb/1,000 gal.
[c]References 8-11.
[d]References 8-10.
[e]Reference 8.

DRAFT

Draft Table 9.12.2-2 (English Units).
VOC EMISSION FACTORS FOR WINE FERMENTATION[a]

EMISSION FACTOR RATING: E

Wine type	Type of control	Ethyl alcohol, lb/10^3 gal[b]	Methyl alcohol, lb/10^3 gal	n-Propyl alcohol, lb/10^3 gal	n-Butyl alcohol, lb/10^3 gal	Sec-Butyl alcohol, lb/10^3 gal	Isobutyl alcohol, lb/10^3 gal	Isoamyl alcohol, lb/10^3 gal	Acet-aldehyde, lb/10^3 gal
Red	None[c]	4.6	0.0025	0.0034	5.5E-5	4.5E-5	0.0036	0.014	0.0027
(SCC 3-02-011-06)	Carbon adsorption[d]	0.17	ND	ND	ND	ND	ND	ND	ND
	Catalytic incineration[e]	1.1	ND	ND	ND	ND	ND	ND	ND
	Wet scrubber[e]	0.056	ND	ND	ND	ND	ND	ND	ND
White	None[c]	1.8	6.4E-4	0.0023	ND	ND	6.9E-4	0.0051	7.2E-5
(SCC 3-02-011-05)	Carbon adsorption[d]	0.092	ND	ND	ND	ND	ND	ND	ND
	Catalytic incineration[e]	0.15	ND	ND	ND	ND	ND	ND	ND
	Wet scrubber[e]	0.083	ND	ND	ND	ND	ND	ND	ND

[a]Emission factor units are lb/1,000 gal of fermented juice produced. SCC = Source Classification Code. ND = no data.
[b]1 lb/1,000 gal = 11.98 g/hl.
[c]References 8-11.
[d]References 8-10.
[e]Reference 8.

DRAFT

There are no available data that can be used to estimate emission factors for the production of sweet table wines, fortified wines, sparkling wines, or brandy.

References for Section 9.12.2

1. R. S. Jackson, *Wine Science: Principles And Application*, Academic Press, San Diego, CA, 1994.

2. M. A. Amerine, *Wine*, in *Kirk-Othmer Encyclopedia Of Chemical Technology*, Third Edition, Volume 24, John Wiley and Sons, New York, 1984.

3. J. A. Heredia, "Technical Assessment Document on Ethanol Emissions and Control from California Wineries", Master of Science Dissertation, California Polytechnic State University, San Luis Obispo, CA, June 1993.

4. M. A. Amerine, *et al.*, *Technology Of Wine Making*, Fourth Edition, AVI Publishing Company, Westport, CT, 1980.

5. G. C. Miller, J. M. Amon, and R. F. Simpson, "Loss of Aroma Compounds in Carbon Dioxide Effluent During White Wine Fermentation", Food Technol. Aust., 39(5):246-249, 1987.

6. Written communication from Dean C. Simeroth, California Air Resources Board, Sacramento, CA, to Mark Boese, San Joaquin Valley Unified Air Pollution Control District (SJVUAPCD), Fresno, CA, November 1, 1994.

7. EAL Corporation, "Characterization of Ethanol Emissions From Wineries", Final Report, Submitted to the California Air Resources Board, Sacramento, CA, July, 1982.

8. *Ethanol Emissions And Control For Wine Fermentation And Tanks*, Report # ARB/ML-88-027, California Air Resources Board, April 1988.

9. C. Castronovo and D. Todd, "Ethanol Emissions Control from Wine Fermentation Tanks Using Charcoal Adsorption: A Pilot Study", California Air Resources Board, published by California Agricultural Technology Institute, March 1990.

10. *Ethanol Emissions Control From Wine Fermentation Tanks Utilizing Carbon Adsorption Technology*, Akton Associates, Martinez, CA, June 1991.

11. Memorandum to Maria Lima, SJVUAPCD, Fresno, CA, from Arthur Caputi, Jr., E&J Gallo Winery, Modesto, CA, December 14, 1992.

DISTILLED SPIRITS COUNCIL OF THE UNITED STATES

TELECOPIER TRANSMITTAL FORM

DATE: January 31, 1997

ATTENTION: Thomas W. Lapp, Ph.D.
MRI

TELECOPIER #: 919/677-0065

FROM: Lynne J. Omlie
DISCUS

We are transmitting 11 pages (including this cover page). If there is a problem with this transmission, please call (202) 628-3544 and ask for Bridget Allshouse.

Tom:

Per your request.

Lynne

Thanks again!
L.

PHILLIP J. SHEPHERD
SECRETARY

BRERETON C. JONES
GOVERNOR

COMMONWEALTH OF KENTUCKY
NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION CABINET
DEPARTMENT FOR ENVIRONMENTAL PROTECTION
DIVISION FOR AIR QUALITY
316 St. Clair Mall
Frankfort, Kentucky 40601

September 23, 1992

Mr. Rafael J. Garcia
THE HOUSE OF SEAGRAM
12700 Shelbyville Road
Barkley Building, Suite 200
Louisville, Kentucky 40243-1599

Dear Mr. Garcia:

Enclosed for your information is a copy of the Statement of Consideration which the Division for Air Quality submitted following the public hearing of 401 KAR 50:037, Emissions fee, held on August 28, 1992.

The regulation was not amended after hearing. The Statement of Consideration was submitted to the LRC on September 11, 1992, and the regulation is on the agenda for the Administrative Regulation Review Subcommittee meeting to be held October 5, 1992 at 2:00 PM in Room 131 of the Capital Annex.

Thank you for your participation in the review process for this regulation. Please call me if you have any questions.

Sincerely,

Richard M. [signature]

for John E. Hornback
Director

JEH/htw

Enclosures

STATEMENT OF CONSIDERATION RELATING TO:

401 KAR 50:037. Emissions fee.

(Not Amended After Hearing)

KENTUCKY NATURAL RESOURCES
AND ENVIRONMENTAL PROTECTION CABINET
Department for Environmental Protection
Division for Air Quality

Public Hearing Conducted
August 28, 1992 - 10:00 AM (ET)
Capitol Plaza Tower Auditorium
Frankfort, Kentucky

Submitted to the
LEGISLATIVE RESEARCH COMMISSION
Pursuant to KRS Chapter 13A

PREFACE

The Kentucky Natural Resources and Environmental Protection Cabinet, Division for Air Quality submits this Statement of Consideration to the Legislative Research Commission as required by KRS 13A.280. The proposed regulation which is the subject of this document was published in the August 1992 issue of the *Administrative Register of Kentucky*. A public hearing to receive oral and written comments was conducted August 28, 1992, in the Capitol Plaza Tower Auditorium, Frankfort, Kentucky. The Cabinet is making no amendments in response to comments presented during the public comment period.

It is the intent of the cabinet for this regulation, 401 KAR 50:037, Emissions fee, to replace the emergency regulation, 401 KAR 50:037E, Emissions fee, which was filed with the Regulations Compiler and became effective July 31, 1992.

This document presents a summary of all relevant comments submitted and the cabinet's responses.

Prominent advertisements of the hearing were published thirty days prior to the hearing in accordance with KRS Chapter 13A and federal regulation 40 CFR 51.102. Public hearing notices and announcement of availability of informational copies of the proposed regulation were distributed to over 1,000 individuals and copies were kept on file for public inspection in the division's regional offices, the Frankfort office, and appropriate county clerks' offices for at least thirty days prior to the hearing.

The services of a court stenographer were secured and the written comments are kept on file at the division's offices in Frankfort, Kentucky. No oral comments were received at the public hearing. Six written statements were received by the close of business on August 28, 1992, and were entered into the public record. A list of those persons attending the public hearing and those giving written comments and their affiliation is included in this document.

Phillip J. Shepherd, Secretary
Natural Resources and Environmental
Protection Cabinet

TABLE OF CONTENTS

PERSONS ATTENDING PUBLIC HEARING

August 28, 1992

Capitol Plaza Tower Auditorium
Frankfort, Kentucky

PERSON	AFFILIATION
Rupert Calalang	LASCO Panel Products
Kim Clawson	Hitachi Automotive Products
Bob Hughes	East Kentucky Power Coop
Kean Jalowy	GTE Products
Larry Decker	The Kingsford Products Company
Jeffery R. Stidam	Walker Construction Company
Don Walker	KLSA
James M. See	Kentucky Power Company
Jim Cloud	Cloud Concrete Products
Jane Tudor	Greenebaum, Doll & McDonald
James Smith	The Kingsford Products Company
Russ Coburn	Kentucky Power Company
Rich Beckett	The Kingsford Products Company
Scott Straight	Louisville Gas & Electric Company
Phillip Gordon	McCoy & McCoy
Caryl Pfeiffer	Kentucky Utilities Company
Craig Johnson	LASCO Panel Products

The following representatives from the Kentucky Natural Resources and Environmental Protection Cabinet were also present at the public hearing.

John B. Hornback
Kenneth M. Hines
Diana Andrews
Diana Hogan
Greg Copley
Millie Ellis*
Martin Luther
Lona Brewer
Donna Moore
H. D. Uriel Smith

* Agency Moderator

PERSONS SUBMITTING TESTIMONY INTO THE PUBLIC HEARING RECORD

August 28, 1992

PERSON	AFFILIATION	TESTIMONY
Bill K. Caylor	Kentucky Coal Association	Written
Tom FitzGerald	Kentucky Resources Council	Written
Rafael J. Garcia	The House of Seagram	Written
Devon E. McClain	Jim Beam Brands Co.	Written
Bob Hughes	East Kentucky Power Coop	Written
Douglas Neeley	U.S. Environmental Protection Agency	Written

401 KAR 50:037. Emissions fee.

---

(1) (a) **COMMENT**

The commentor points out that the major emission from coal operations is dirt, primarily from roads associated with coal preparation plants. He feels that it is not equitable for emitters of dirt to pay the same fees as sources which emit chemicals. (B. Caylor)

(b) **RESPONSE**

The Cabinet does not concur. The commentor implies that the health effects from particulate matter emitted from coal processing plants (specifically, the dust emitted from the haul roads at such sources) are less onerous than the health effects caused by sulfur dioxide, oxides of nitrogen, volatile organic compounds, and ethyl alcohol. There is, however, a primary National Ambient Air Quality Standard for particulate matter which is designed to protect public health, and which must be enforced by the Cabinet. The enforcement of this standard and the issuance and enforcement of permits required for sources of particulate matter, require that the Cabinet take the same actions and perform the same functions as those directed to sources of other pollutants. It is worthwhile to note that the emissions fee mandated in Title V of the Clean Air Act Amendments of 1990 also must include a fee for the emissions of particulate matter.

(2) (a) **COMMENT**

The commentor states that there is no difference between coal haul roads which are required to pay emissions fees and county or farm roads which are not required to pay emissions fees. (B. Caylor)

(b) **RESPONSE**

The Cabinet does not concur. 401 KAR 50:035, Section 6(15), Permits, provides an exemption for sources that are "emitters of non-process fugitive emissions that are not part of a source that is otherwise subject to regulation." This exemption prevents the cabinet from requiring permits for the kinds of sources identified by the commentor. The exemption contained in the Kentucky regulation is consistent with the requirements of the U.S. EPA and with the practices of other states. For Kentucky to require permits from such sources without proper justification, would cause our regulation to more stringent than is mandated by the U.S. EPA.

(3) (a) **COMMENT**

The commentor suggests that if coal processing plants cannot be totally exempted from paying the emissions fee, then there needs to be a nominal emissions fee rate applied to those parts of coal operations with emissions of dirt (soil). (B. Caylor)

(b) **RESPONSE**

The cabinet does not concur. The statutory authority for the assessment of emissions fees, H.B. 468, requires that fees shall be uniformly assessed among sources which emit sulfur dioxide, oxides of nitrogen, particulates, and VOCs. A nominal emission fee for particulates would violate the statute. See also response to Comment #1.

(4) (a) **COMMENT**

The commentor points out that there is an apparent inconsistency in the Regulatory Impact Analysis as to whether additional reporting is required. He states that the agency acknowledges that some sources not presently required to do so will be required to update their emission inventories on an annual basis and in the same paragraph says that no additional reporting will be required. (T. FitzGerald.)

(b) **RESPONSE**

The cabinet concurs. A better wording of the third sentence in paragraph (1)(b) of the Regulatory Impact Analysis would have been, "Beyond this additional annual report, no additional paperwork is required.

(5) (a) **COMMENT**

The commentor recommends that the emission factor for whiskey aging facilities (10 pounds per barrel per year) be revised to not more than 7.4 pounds per barrel per year. (D. McClain)

(b) **RESPONSE**

The Cabinet concurs. Although this appears to be a comment on the validity of the data contained in the Kentucky Emissions Inventory System (KyEIS) rather than a comment on the regulation itself, the Cabinet recognizes that it addresses an issue directly related to the application and enforcement of the proposed regulation. Therefore, this response is offered in the Statement of Consideration:

As a result of the comments offered by the Task Force for Implementation of the Clean Air Act Amendments of 1990, which considered the proposed regulation, the Division for Air Quality initiated discussions with the U.S. EPA regarding the emission factor contained in the U.S. EPA publication AP-42 for evaporative losses from whiskey warehouses. As a result of those discussions, the U.S. EPA has indicated to the division that it intends to revise the emission factor from ten pounds per barrel per year to 7.6 pounds per barrel per year. While the U.S. EPA has not completed that revision, the Division for Air Quality has modified the factor used to calculate emissions subject to the fee contained in the proposed regulation from ten pounds per barrel per year to 7.6 pounds per barrel per year. While this amendment does not match exactly the figure proposed by the commentor (7.4 pounds per barrel per year) the Cabinet has determined the minor discrepancy is justified in order to remain consistent with the use of emission factors approved by the U.S. EPA to calculate emissions for other source categories.

(6) (a) **COMMENT**

The commentor requests that the emission factor for whiskey aging facilities (10 pounds per barrel) be revised to not more than 7.5 pounds per barrel per year. (R. Garcia)

(b) **RESPONSE**

See response to Comment #5.

(7) (a) **COMMENT**

The commentor states that the dates provided in Section 3 of this regulation should be revised to reflect the current dates for the adoption of this regulation, since it is obvious that the 1992 assessment will not be made by July 1, 1992. He further states that the dates established for the 1993 fee rates should also reflect the dates that actions are expected to occur in 1993. (B. Hughes)

(b) **RESPONSE**

The Cabinet does not concur. In order to allow as much flexibility as possible to sources who wish to review and update their actual emission entry in the KyEIS, the phrase, "or as soon after each date as practicable," was included in the regulation to make it clear that the July 1, 1992 and July 1, 1993, dates are goal dates and that additional time would be needed for the division to work with sources to arrive at the most accurate emissions inventory data possible.

(8) (a) **COMMENT**

The commentors point out that the inventory reporting requirements of this regulation do not fully satisfy the State Implementation Plan requirements in Section 182(a)(3)(B) of the 1990 Clean Air Act Amendments. (T. FitzGerald, D. Neeley)

(b) **RESPONSE**

The Cabinet concurs. The Division for Air Quality had considered submitting this regulation to EPA as a revision to Kentucky's SIP in order to meet the inventory reporting requirement established in the CAAA. However, the division has determined that there are other more appropriate measures for revising the SIP and will no longer be submitting this regulation as a SIP revision.

SUMMARY

Seventeen individuals from the general public and ten division staff members attended the public hearing for 401 KAR 50:037. No oral comments were received at the hearing. The Division for Air Quality received comments from six individuals during the public comment period. These individuals represented two whiskey aging facilities, one environmental advocacy agency, one association for Kentucky coal producers, one electrical utility company, and the U.S. EPA.

The division has determined that no amendments to the regulation are necessary based on the comments which were received.