ENGINEERING DIVISION REPORT

ON

AREA SOURCE EMISSIONS FOR C/Y 1983

FROM

AGRICULTURAL LIVESTOCK WASTE

CES. NO. 66605

OCTOBER 6, 1984

BY

EARL D. HALBERG, P.E., AIR QUALITY ENGINEER II

EMISSIONS INVENTORY UNIT

Sanford M. Weiss

Director of Engineering

Deanne 2-0175

Post-it™ brand fax transmittal memo 7671 | # of pages ▸

To Low Ashbaugh	From Bong Kim
Co. UCD	Co. SCAQMD
Dept.	Phone # (909)396-3157
Fax # (916)752-4107	Fax #

INTRODUCTION

This catagory is used to provide an estimate of fugitive hydrocarbon emissions from the natural decomposition of farm animal manures. This is a new source assessment catagory for which there are no EPA emission factors, or ARB Guidelines.

Biological decomposition of animal wastes has been extensively studied as a source of fuel energy, and to assess the health effects on confined animals.[11-13] These studies primarily investigated the extraction of methane gas for fuel, or the toxic effects of the many gaseous compounds emitted from manure beds. Very little information has been published which links the evolution of Total Organic Compounds (TOC) from animal wastes to the Air Quality Assessment of a region. The estimated emissions summarized in Table III indicate a potential which may warrant a much more detailed analysis than this initial evaluation.

METHOD

The basic animal population numbers were taken from the annual reports of the Agricultural Commissions of the four counties.[1-4] Agricultural reports are generated for economic measurement and base most of their counts on head sold or head produced. These had to be modified by contacts with County Veterinarians, Farm Advisors, and Brand Inspectors to establish statistical populations, and separate animals into SoCAB or SEDAB areas.[5-10]

The headcounts in Table II are the results of these inquiries and are an estimated average population.

EMISSION FACTORS

The EPA and ARB have not published any emission factors related to the Biological Decomposition of Animal Manures.[14-15] Several other potential sources were investigated and found to either contain no quantitative data, or the data resulted from the use of chemical processes.[11-13] One of the references had abstracts of over 100 books, reports or papers on the subject of animal wastes.[13] The only material found to link animal wastes to non-point emissions was a report by KVB.[16] The following emission factors were taken from that report.

KVB Report

TABLE I

EMISSION FACTORS FOR TOC FROM ANIMAL WASTES[16]

	LBS TOC/10^3 HEAD-DAY	TONS TOC/10^3 HEAD-YEAR
Cattle	440.5	80.4
Horses	229.3	41.8
Pigs	160.0	29.2
Sheep	33.2	6.1
Chickens	7.0	1.3

None of the emission factors above has been verified by SCAQMD tests or analysis. The reference source quoted in the KVB Report could not be located by the SCAQMD Technical Library Staff.

ASSUMPTIONS

1. All of the organic emissions are considered non-reactive.
2. The statistical populations of farm animals are reasonably accurate and are in the proper air basins.
3. The emission factors listed in Table I are appropriate for use with the statistical populations of Table II.
4. Manures have been allowed to reach their full natural state of decomposition.
5. All manure deposited was considered without any allowance for rapid removal and commercial processing.

TEMPORAL

The emissions were considered to be uniform on an annual and weekly basis. Actual emissions would probably increase during daylight hours especially on sunny days following rain.

SAMPLE CALCULATION

The estimated emissions tabulated in Table III were calculated by the following mathematical relationship:

EMISSIONS = (Process Rate) X (Emission Factor) = tons TOC/YEAR

WHERE: Process Rate = 1000 head (Table II)

Emission Factor = tons TOC/1000 head/yr (Table I)

EXAMPLE: Total organic compound emissions from dairy cattle manure in the South Coast Air Basin portion of Riverside County.

PROCESS RATE = 103,000 head

EMISSION FACTOR = 80.4 tons/1000 head-year

EMISSIONS = (103,000 head) x (80.4 tons/1000 head-year)
= 8281.2 tons TOC/year

The above procedure was used to calculate the emissions for all animal species by Districts and the results are tabulated in Table III.

TABLE II

STATISTICAL FARM ANIMAL POPULATION [1-10]

1983

	Los Angeles Co.		Orange Co.	Riverside Co.		San Bernardino Co.
	SoCAB	SEDAB	SoCAB	SoCAB	SEDAB	SoCAB
Beef Cattle	5,500	7,000	2,500	33,000	1,500	38,000
Dairy Cattle	36,000	4,000	0	103,000	-	170,000
Horses	84,000	16,000	2,000	65,000	10,000	12,000
Pigs	6,500	3,500	-	1,000	-	
Sheep & Goats	6,000	67,000	-	25,000	-	22,500
Chickens & Fowl	1,655,000	68,000	20,000	2,744,000	-	1,600,000

TABLE 1

EMISSIONS OF TOTAL ORGANIC GASES FROM FARM ANIMALS WASTES

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT 1983

ANIMAL/SPECIES	TONS/YEAR								
	LOS ANGELES		ORANGE	RIVERSIDE		SAN BERNARDINO	DISTRICT TOTALS		
	SoCAB	SEDAB	SoCAB	SoCAB	SEDAB	SoCAB	SoCAB	SEDAB	SCAQMD
Beef Cattle	442	563	201	2653	121	3055	6351	684	7035
Dairy Cattle	2894	322	0	8281	0	13,668	24,843	322	25,165
Horses	3511	669	84	2717	418	502	6814	1087	7901
Pigs	190	102	0	29	0	0	219	102	321
Sheep and Goats	37	409	0	153	0	137	327	409	736
Chickens and Fowl	2152	88	26	3567	0	2080	7825	88	7913
TOTALS	9226	2153	311	17,400	539	19,442	46,379	2692	
GRAND TOTAL									49,071

000237

ASSESSMENT

This report used standard practice methods and procedures throughout and concluded with what should be reasonably accurate results. The only degree of uncertainty is in the Unverifiable Emission Factors.

For purposes of comparison, one reference reported the output of a manure gasification plant as 1,000,000 ft^3/day of methane from 340 tons/day of manure produced by 50,000 cattle.[11] This converts to 163 tons/year/1000 head, or about twice the emission factor used in this report. The order of magnitude difference between the manufactured gas and that from natural decomposition indicates that the factors used may be reasonable values.

TABLE III

EMISSIONS OF TOTAL ORGANIC GASES FROM FARM ANIMALS WASTES

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT 1987

ANIMAL/SPECIES	TONS/YEAR								
	Los Angeles		Orange	Riverside		San Bernardino	DISTRICT TOTALS		
	SCAB	SEDAB	SCAB	SCAB	SEDAB	SCAB	SCAB	SEDAB	SCAQMD
Beef Cattle	217	257	482	2,894	121	499	4,212	378	4,590
Dairy Cattle	342	40	---	9,248	---	14,673	24,281	40	24,321
Horses	3,323	3,323	678	2,174	536	2,132	8,507	4,159	12,666
Pigs	123	76	3	9	---	222	357	76	433
Sheep & Goats	15	334	---	244	---	65	324	334	658
Chickens & Fowl	1,853	206	37	4,002	---	1,879	7,771	206	7,977
TOTALS:	5,893	4,236	1,400	18,569	957	19,590	45,452	5,193	
GRAND TOTAL:									50,665

REFERENCES

1. County of Los Angeles, Crop and Livestock Report, 1983.

2. Agricultural Crop Report, Orange County, 1983.

3. Annual Crop and Livestock Report, County of San Bernardino, 1983.

4. Riverside County Agricultural Crop Report, 1983.

5. Mr. Knight, Los Angeles Co. Agricultural Office, El Monte, CA.

6. Dr. Haight, Orange Co. Veterinarian, Santa Ana, CA.

7. Jim Sullins, Farm Advisor, San Bernardino, CA.

8. Jack Odway, Brand Inspector, Hemet, CA.

9. Niel Gum, California Dept. of Livestock Statistics, Sacramento, CA.

10. Del Pedro, Chief, Bureau of Livestock Identification, Sacramento, CA.

11. Klass and Emert, Fuels From Biomass and Wastes, Ann Arbor Science Publisher's, Inc., 1981.

12. Aschbacher, Air Pollution Research Needs: Livestock Production, APCA Journal, April 1973.

13. Rowe and Merryman, Livestock and the Environment, A Bibliography with Abstracts, Oklahoma State University, February 1980.

14. Methods For Assessing Area Source Emsisions in California, Air Resources Board, State of California, December 1982.

15. AP-42 U.S. Environmental Protection Agency.

16. Harold Taback, et.al., Control of Hydrocarbon Emissions From Stationary Sources in the California South Coast Air Basin, Final Report By KVB, Inc., Tustin, CA., December 1977.