United States
Environmental Protection
Agency

Control Technology
Center
Research Triangle Park NC 27711

EPA-450/3-89-028
June 1989

EPA

Evaluation of Emission Sources from Creosote Wood Treatment Operations

control technology center

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EPA-450/3-89-023
June 1989

EVALUATION OF EMISSION SOURCES FROM CREOSOTE WOOD TREATMENT OPERATIONS

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EPA Contract No. 68-02-4379

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DISCLAIMER

This document presents the results of an engineering evaluation of emission sources from creosote wood treatment operations. Specifically, the document discusses the history of the wood preserving industry, the various techniques used to preserve wood, and the air emissions associated with the Boulton process. The EPA does not represent that this document comprehensively sets forth all of the procedures used in wood treatment operations, or that it describes applicable legal requirements which vary among the States.

Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

ACKNOWLEDGEMENT

This engineering assistance report for wood treatment operations was prepared for EPA's Control Technology Center (CTC) by C. C. Vaugnt, and R. L. Nicholson of Midwest Research Institute. Bruce Moore of EPA's Office of Air Quality Planning and Standards was the Work Assignment Manager.

PREFACE

The wood treatment engineering assistance project was funded by EPA's Control Technology Center (CTC). The CTC was established by EPA's Office of Research and Development (ORD) and Office of Air Quality Planning and Standards (OAQPS) to provide technical assistance to State and local air pollution control agencies. Three levels of assistance can be accessed through the CTC. First, a CTC HOTLINE has been established to provide telephone assistance on matters relating to air pollution control technology. Second, more in-depth engineering assistance can be provided when appropriate. Third, the CTC can provide technical guidance through publication of technical guidance documents, development of personal computer software, and presentation of workshops on control technology matters.

The engineering assistance projects, such as this one, focus on topics of national or regional interest that are identified through contact with State and local agencies. In this case, the CTC was contacted by the Virginia Air Pollution Control Board with a request for information about odor (and potential air toxics) control at creosote wood treatment facilities. Specifically, the agency requested available information on controls designed to limit emissions during the time the treated wood is withdrawn from the retort and is cooled outdoors. As a result, the EPA's Emission Standards Division (ESD) contracted with the Midwest Research Institute (MRI) to conduct an engineering evaluation of the wood preserving process. This report presents the results of that evaluation. The report discusses the history of the wood preserving industry, the various techniques used to preserve wood, and the air emissions associated with the Boulton process.

TABLE OF CONTENTS

Page

LIST OF TABLES

1.0 INTRODUCTION

Wood preservation is the pressure or thermal impregnation of chemicals into wood to a depth that will provide effective long-term resistance to attack by fungi, insects, and marine borers. By extending the service life of available timber, wood preservation reduces the harvest of already stressed forestry resources, reduces operating costs in industries such as utilities and railroads, and ensures safe working conditions where timbers are used as support structures.

The three preservatives predominantly used in the U.S. for wood preservation are pentachlorophenol; creosote; and aqueous formulations of arsenic, copper, chromium or ammonia.

The wood preservation process deposits or fixes these chemicals in the wood, and the toxic nature of the chemicals effectively prevents the attack of living organisms on the wood. Because the chemicals are also toxic to varying degrees to humans and aquatic organisms, their use in industry must be carefully controlled. This document will discuss each of the preservatives and the various processes used to treat a variety of wood products concentrating on the use of creosote for the treatment of crossties. Of particular concern will be the emission sources associated with the release of odor and air toxics and the technologies currently in use to control them.

2.0 THE WOOD PRESERVING INDUSTRY--PAST AND PRESENT

2.1 HISTORICAL SKETCH

The need to protect wood from various forms of decay has been recognized since ancient times. The use of chemical preservatives to perform this function did not come into widespread use in this country until the early 1900's. At that time, the expansion of railroad systems throughout the country created a need for a durable, weather-resistent material from which railroad ties could be made. Wood treatment with creosote, an oily liquid mainly consisting of aromatic hydrocarbons, was found to fill the need, resulting in large-scale use of creosote-treated products.

The need for a building material that could survive in marine environments presented another use for preserved wood. Again, creosote was found to be effective in most instances, providing protection to docks, underwater posts, and wharfs. However, attack by the marine borer Limnoria tripunctata, commonly known as "gribble," can destroy creosote-treated wharfs. This led to the discovery that a dual treatment of copper arsenate salts followed by creosote was successful in resisting gribble attack.

There was also a need for a clean, more paintable product not having the appearance or odor of creosote-treated wood. Therefore, an intensified search for alternatives to creosote was undertaken. Two types of preservatives were identified to achieve this: waterborne preservatives--inorganic salts in a water carrier, and pentachlorophenol (PCP)--a crystalline compound applied in a light oil carrier. Both provided protection from decay while producing a product that could be used in many applications where creosote-treated products could not.

With treated wood products successfully demonstrated, utility companies, construction companies, steamship lines, road maintenance organizations, and various other groups saw potential uses for treated wood. These uses would ultimately include poles, pilings, plywood, fence posts, guardrails, bridge structures, boardwalks, and other lumber and timber products. New demands for treated wood created a need for more versatile products and a much greater production capacity.

2.2 CURRENT INDUSTRY STATUS

A recent survey of the wood preserving industry reports that 588 wood preserving plants were in operation in 1986.[1] Most treatment plants (508) used only one type of preservative: 414 treated only with waterborne preservatives, almost all of which were arsenicals; 58 treated only with creosote; and 36 treated only with pentachlorophenol. The other 80 active plants used various combinations of two or more preservatives. The total industry consumption of preservative and fire retardants in 1986 was reported as follows:[1]

1. 117 plants treating with creosote solutions consumed 89.9 million gallons of creosote and creosote-coal tar, and 16.5 million gallons of petroleum solvent to treat 119 million ft^3 of wood products.

2. 96 plants treating with pentachlorophenol consumed 22.1 million pounds of pentachlorophenol and 32.4 million gallons of petroleum solvent to treat 50 million ft^3 of wood products.

3. 475 plants treating with waterborne preservatives consumed 130.8 million pounds of preservative salts to treat 375 million ft^3 of wood products.

4. 79 plants treating with fire retardants consumed 24.6 million pounds of fire retardant chemicals to treat 10 million ft^3 wood products. A more detailed products breakdown is presented in Table 1.

Seventy-five percent of the wood treatment plants in the U.S. are concentrated in two distinct regions. One area extends from east Texas to Maryland and corresponds roughly to the natural range of southern pines, the major species utilized. The second, smaller area is located along the Pacific coast, where Douglas fir and western red cedar are the predominant species. The remaining 25 percent of plants are scattered throughout the U.S. Table 2 presents the distribution of wood preserving plants in the U.S. in 1986 by State and region. The production of treated wood in 1986 is listed in Table 3 by U.S. region for 518 reporting plants. Table 4 presents the production data for pressure treating plants in 1986 by type of preservative used.

TABLE 1. PRODUCTION VOLUME OF TREATED WOOD IN THE UNITED STATES IN 1986[1]
(ft^3 treated x1,000)

Products	Volume treated with				
	Creosote solutions[a]	Penta-chlorophenol	Waterborne preservatives	Fire retardants	All chemicals
Crossties	79,858	585	--	--	80,443
Switch and bridge ties	5,907	--	--	--	5,907
Poles	16,196	42,003	15,142	--	73,341
Piling	5,342	237	4,903	--	10,482
Fence posts	1,674	1,647	14,020	--	17,341
Lumber	3,517	2,778	285,718	5,862	297,875
Timbers	2,893	878	28,389	119	32,279
Plywood	--	34	4,924	4,344	9,302
Other products	3,362	1,322	22,362	87	27,133
All products--1986	118,749	49,484	375,458	10,412	554,103

[a] Creosote, creosote-coal tar, and creosote-petroleum.

TABLE 2. WOOD PRESERVING PLANTS IN THE UNITED STATES, BY REGION AND STATE

	Active plants, 1986				
	Pressure	Nonpressure	Total	Inactive, 1986	New plants, 1987
Northeast					
Connecticut	1		1		
Maine	1		1		
Maryland	9		9		
Massachusetts	4		4		
New Hampshire	1		1		
New Jersey	4		4		
New York	10		10		
Pennsylvania	21		21		
Rhode Island	1		1		
Vermont				1	
West Virginia	12	1	13	1	
TOTAL	64	1	65	2	0
North Central					
Illinois	12		12		2
Indiana	10		10		1
Iowa	1		1		
Kansas	1		1		
Kentucky	10		10		
Michigan	14	1	15	1	
Minnesota	6	2	8	1	
Missouri	13	4	17	1	
Nebraska	2		2		
North Dakota	1		1		
Ohio	11		11		1
Wisconsin			13		1
TOTAL	94	7	101	3	5
Southeast					
Florida	38		38		1
Georgia	55		55		2
North Carolina	31	1	32	1	
South Carolina	15		15		
Virginia	30	1	31		1
Puerto Rico	5		5		
TOTAL	174	2	176	2	4
South Central					
Alabama	52		52	1	1
Arkansas	21		21		1
Louisiana	26		26	1	
Mississippi	26		26		1
Oklahoma	3		3		1
Tennessee	8		8		1
Texas	32	1	33		1
TOTAL	168	1	169	2	6
Rocky Mountain					
Arizona	1		1		
Colorado	7		7		
Idaho	5	3	8		
Montana	3	2	5		
New Mexico	1		1		
South Dakota	5		5		
Utah	2	1	3		
Wyoming	3		3		
TOTAL	27	6	33		

(continued)

TABLE 2. (continued)

	Active plants, 1986				
	Pressure	Nonpressure	Total	Inactive, 1986	New plants, 1987
Pacific Coast					
California	14		14		
Oregon	9		9		
Washington	13	1[a]	14[a]		
Hawaii	7		7		1
TOTAL	43	1	44	0	1
UNITED STATES	570	18	588	9	16

[a] Includes one plant located in British Columbia.

TABLE 3. TREATED WOOD PRODUCTION, 1986[1]
(ft^3 x1,000)

Region	No. of plants reporting	Volume treated with				
		All chemicals	Creosote solutions[a]	Penta-chlorophenol	Waterborne preservatives	Fire retardants
Northeast	54	46,661	11,245	769	33,357	1,290
North Central	87	72,637	21,159	6,125	43,949	1,404
Southeast	164	165,084	14,906	8,172	138,584	3,422
South Central	144	155,891	50,097	18,633	85,344	1,817
Rocky Mountain	27	9,665	1,585	2,849	5,042	189
Pacific Coast	42	53,746	10,986	10,213	31,228	1,319
All Regions	518[b]	503,681	109,977	46,761	337,503	9,440

Note: Components may not add to totals, due to rounding.

[a] Creosote, creosote-coal tar, and creosote-petroleum.
[b] Includes 500 pressure-treating plants and 18 nonpressure-treating plants.

TABLE 4. TREATED WOOD PRODUCTION BY TYPE OF PRESERVATIVE--PRESSURE TREATING PLANTS, 1986[1]

Plants treating with	No. of plants	No. of retorts	Retorts void, ft^3	Volume of wood treated, ft^3	Volume treated with (ft^{3}x1,000)				Volume treated per ft^3 cylinder volume
					Creosote	Penta	Water	FR[a]	
Creosote	51	134	634,014	70,927,939	70,923	--	--	--	111.9
Creosote/penta	15	44	212,500	20,777,172	8,707	12,070	--	--	97.8
Creosote/water	15	44	125,076	19,372,768	11,977	--	7,120	276	154.9
Penta/water	19	45	136,691	23,193,569	--	9,426	13,576	192	169.7
Penta	17	23	56,308	5,639,070	--	5,639	--	--	100.1
Water	299	391	661,653	228,256,413	--	--	228,256	--	345.0
Water/FR	62	126	220,828	78,620,169	--	--	70,422	8,198	356.0
Creosote/penta/water	19	90	412,849	44,219,047	18,357	13,725	11,363	774	107.1
ALL PLANTS	497	897	2,459,919	491,006,147	109,969	40,861	330,736	9,440	

Note: Nonpressure plants are excluded.

[a]FR = fire retardant.

3.0 OVERVIEW OF WOOD PRESERVATION

This chapter discusses the types of preservatives used to treat various wood products and the processes by which these preservatives are applied. The wood treatment process generally has two stages, a conditioning stage that serves to remove moisture from the wood (which allows for greater penetration of preservative) followed by a treatment stage during which the preservative is forced into the wood, usually by means of pressure.

3.1 WOOD PRESERVATIVES

Wood preservatives fall into two general classes: oils, such as creosote and petroleum solutions of pentachlorophenol, and waterborne salts that are applied as water solutions. Preservatives vary greatly in effectiveness and in suitability for different purposes and use conditions. The effectiveness of any preservative depends not only upon its composition but also upon the quantity injected into the wood, the depth of penetration, and the conditions to which the treated material is exposed in service.[2]

Table 5 shows the types of preservative oils and waterborne salts that are used to treat various types of wood products and the minimum required preservative retention (pounds of preservative per cubic foot of wood) for each product/preservative combination. Although the majority of wood products are treated with waterborne preservatives, this report is concerned with the odors that are emitted when creosote or creosote solutions are used. Therefore, the following discussions focus primarily on creosote and creosote solutions and the types of wood treatment processes that use these preservative oils.

3.1.1 Preservative Oils

Creosote and solutions with heavier, less volatile petroleum oils often help protect wood from weathering but may adversely influence its cleanliness, odor, color, paintability, and fire resistance. Volatile oils or solvents with oilborne preservatives, if removed after treatment, leave the wood cleaner than the heavier oils but may not provide as much protection.[3]

TABLE 5. PRESERVATIVES AND MINIMUM RETENTIONS FOR VARIOUS WOOD PRODUCTS

Form of product and service condition	Preservative oils						Waterborne preservatives		
	Coal-tar creosote	Creosote-coal-tar solution	Creosote-petroleum solution	Pentachlorophenol			Acid copper chromate	Ammoniacal copper arsenate	Chromated copper arsenate Types I, II, or III
				In heavy petroleum	In light petroleum	In volatile solvents			
	Pounds per cubic foot								
A. Ties (crossties and switch ties)	7–10	7–10	7–10	0.35–.50	—	—	—	—	—
B. Lumber, plywood, and structural timbers (including glued laminated)									
(1) For use in coastal waters:									
Lumber (under 5 in thick)	20–25	—	—	—	—	—	—	2.50	2.50
Timbers (5 in or thicker):									
Southern pine	20–25	—	—	—	—	—	—	2.50	2.50
Coast Douglas-fir and western hemlock	20–25	—	—	—	—	—	—	2.50	2.50
Plywood	25	—	—	—	—	—	—	2.50	2.50
(2) For use in fresh water, in contact with ground, or for important structural members not in contact with ground or water	7–12	7–12	7–12	.50–.60	.62–.75	.62–.75	—	.60	.60
Glued-laminated timbers or laminates	6–12	6–12	6–12	.60	.75	.75	—	.60	.60
(3) For other uses not in contact with ground or water	6–12	6–12	6–12	.30–.40	.30–.40	.30–.40	0.25–0.50	.250	.250
C. Piles									
(1) For use in coastal waters:									
Southern pine	25	25	—	—	—	—	—	2.50	2.50
Coast Douglas-fir	22	—	—	—	—	—	—	2.50	2.50
(2) For land or fresh-water use:									
Southern and other pines	12	12	12	.60	—	—	—	.60	.60
Douglas-fir and western	17	17	17	.65	—	—	—	1.00	1.00

TABLE 5. (continued)

Form of product and service condition	Preservative oils						Waterborne preservatives		
	Coal-tar creosote	Creosote-coal-tar solution	Creosote-petroleum solution	Pentachlorophenol			Acid copper chromate	Ammoniacal copper arsenate	Chromated copper arsenate types I, II, or III
				In heavy petroleum	In light petroleum	In volatile solvents			
	Pounds per cubic foot								
D Poles (utility)									
Southern and ponderosa pine	9.0	—	—	.45	.56	.56	—	.60	60
Red pine	13.5	—	—	.68	.85	.85	—	.60	.60
Jack and lodgepole pine	16.0	—	—	.80	1.00	1.00	—	.60	.60
Coast Douglas-fir	12.0	—	—	.60	.75	.75	—	.60	.60
Interior Douglas-fir and western larch	16	—	—	.80	1.00	1.00	—	.60	60
Western redcedar	16	—	—	.80	1.00	1.00	—	—	—
Western redcedar, northern white-cedar, Alaska-cedar, lodgepole pine ("thermal" or hot-and-cold process)	20	—	—	1.0	—	—	—	—	—
E Poles (building, round)	12–13.5	—	—	.60	—	—	—	.60	.60
F. Posts (round)									
Fence	6	6	7	30	.38	.38	.50	.40	.40
Building	12	—	—	.60	—	—	—	.60	60

NOTE: Minimum retentions are those included in Federal Specification TT–W–571 and Standards of the American Wood-Preservers' Association. The current issues of these specifications should be referred to for up-to-date recommendations and other details. In many cases the retention is different depending on species and assay zone.

3.1.1.1 Coal Tar Creosote. Coal tar creosote, a black or brownish oil made by distilling coal tar, is highly toxic to wood-destroying organisms and has a long record of satisfactory use as a wood preservative. The American Wood Preservers' Association describes creosote, as used by the wood preservation industry, as: "a distillate of coal tar produced by high temperature carbonization of bituminous coal: it consists principally of liquid and solid aromatic hydrocarbons and contains appreciable quantities of tar acids and tar bases; it is heavier than water, and has a continuous boiling range of at least 125°C, beginning at about 200°C."[4]

The first fractions from coal tar distillation contain the light (or low molecular weight) oils, and the residue left after completion of the process is the pitch. The higher boiling point liquid fraction recovered between these two general classes of materials is creosote. Relative concentrations of creosote components can vary because the character of the tar, details of the distillation process, and proportion of distillate included in the creosote fraction all influence the composition of the creosote. Table 6 summarizes the chemical and physical properties of creosote, and Table 7 lists the major components of creosote.

Most of the 200 or more compounds in creosote are polycyclic aromatic hydrocarbons (PAH's). Only a limited number of these compounds (less than 20) are present in amounts greater than 1 percent. The major polycyclic aromatic hydrocarbons in creosote listed in Table 7 generally comprise at least 75 percent of the creosote.[5]

The many components in creosote complement each other in effecting wood preservation. The lighter molecular weight PAH's in creosote are generally more toxic to decay organisms. The heavier molecular weight components of creosote help "retain" the lighter, more toxic components within the wood by minimizing leaching or volatilization. The heavier residues of creosote, when impregnated into wood, prevent moisture changes and subsequently minimize splitting of wood.

The advantages of coal tar creosote include: (1) relative insolubility in water and low volatility, which impart to it a great degree of permanence under the most varied use conditions; (2) ease of application; (3) ease with which its depth of penetration can be

TABLE 6. PHYSICAL AND CHEMICAL PROPERTIES OF CREOSOTE[5]

Identification	
Common:	Creosote oil
Synonym:	Coal tar creosote
CAS Registry No.:	8001-58-9
Physical and chemical properties	
Physical state:	Liquid
Solubility:	Insoluble in water. Soluble in alcohol, benzene, and toluene
Specific gravity:	1.05-1.09 at 15°C (sinks in fresh and marine waters)
Vapor pressure:	Variable
Boiling point:	200° to 540°C
Odor:	Acrid, tarry aromatic
Vapor density:	Variable
Appearance:	Yellow to black oily liquid with sharp, smoky or tarry odor
Melting point:	Varies (-60° to -20°C)
Flash point:	>74°C-combustible liquid
Explosive limits:	Variable, 1 to 7 percent
Hazard data	
Fire	
Extinguishing data:	Use dry chemical, foam, or carbon dioxide. Use water to cool fire-exposed containers
Fire behavior:	Forms irritating heavy black smoke
Ignition temperature:	Variable, typically 400°C
Burning rate:	4 mm/min
Reactivity	
With water:	No reaction, insoluble
With common materials:	May react with oxidizing agents or strong acids
Stability:	Stable

TABLE 7. MAJOR COMPONENTS IN CREOSOTE[5]

Component	Whole creosote, percent[a]	Boiling point, °C.$_{760}$[b]	Melting point, °C[b]	Molecular weight
Naphthalene	~ 3.0	218	80.55	128.2
2-Methylnaphthalene	~ 1.2	241.05	24.58	142.2
1-Methylnaphthalene	~ 0.9	244.64	-22	142.2
Biphenyl	~ 0.8	255.9	71	154.2
Dimethylnaphthalenes	~ 2.0	268	-18-104	156.2
Acenaphthalene	~ 9.0	279	96.2	156.2
Dibenzofuran	~ 5.0	287	86-87	168.2
Fluorene	~ 10.0	293-295	116-117	166.2
Methylfluorenes	~ 3.0	318	46-47	180.2
Phenanthrene	~ 21.0	340	101	178.2
Anthracene	~ 2.0	340	216.2-0.4	178.2
Carbazole	~ 2.0	355	247-248	167.2
Methylphenanthrenes	~ 3.0	354-355	65-123	192.2
Methylanthracenes	~ 4.0	360	81.5-209.5	192.2
Fluoranthene	~ 10.0	382	111	202.3
Pyrene	~ 8.5	393	156	202.3
Benzofluorenes	~ 2.0	413	189-190	216.3
Chrysene	~ 3.0	448	255-256	228.3
	90.4			

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[a] Approximate pct. ±0.7 percent.

[b] Values from Handbook of Chemistry and Physics, 1971-72, 52nd ed., Chemical Rubber Publishing Company, Cleveland, Ohio.

determined; and (4) general availability and relative low cost (when purchased in wholesale quantities). Some disadvantages of coal tar creosote are: (1) creosote-treated wood usually cannot be painted satisfactorily, (2) the odor of creosote-treated wood is unpleasant to some persons, (3) creosote vapors are harmful to growing plants, and (4) creosote-treated wood can cause skin irritation or burns when it is handled.[3]

3.1.1.2 Creosote Solutions. Either coal tar or petroleum oil can be mixed with coal tar creosote, in various proportions, to lower preservative costs. The creosote solutions have a satisfactory record of performance, particularly for crossties where they have been most commonly used.[3] Mixtures of coal tar and coal tar creosote commonly contain about 20 to 50 percent tar by volume.[2] In general, mixtures of coal tar creosote and petroleum may contain 30 to 70 percent petroleum by volume, but the content is usually about 50 percent.[2] (For crossties and switchties, the tar content is about 40 to 50 percent.)[3] Creosote-coal tar solutions penetrate the wood with greater difficulty because they generally are more viscous than straight creosote. However, high temperatures and pressures during treatment, when they can safely be used, will often improve penetration of high viscosity solutions.

Creosote petroleum solutions and creosote-coal tar solutions help to reduce checking (splitting) and weathering of the treated wood. Frequently posts and ties treated with standard formulations of these solutions performed better than those similarly treated with straight coal tar creosote.[3]

3.1.1.3 Pentachlorophenol Solutions. There are several types of pentachlorophenol solutions used in wood preservation: mineral spirits, heavy petroleum oils, and liquid petroleum gas are all solvents that can be used with pentachlorophenol for wood treatment. Pentachlorophenol solutions generally contain 7.5 percent (by weight) of this chemical although solutions with volatile solvents may contain lower or higher concentrations.[3]

The performance of pentachlorophenol and the properties of the treated wood are influenced by the properties of the solvent used. Heavy petroleum solvents are preferable for maximum protection, particularly where the treated wood is used in contact with the ground. The heavy oils remain in the wood for a long time and do not usually provide a clean or paintable surface. Therefore, volatile solvents, such as liquified petroleum gas and methylene chloride, are used with pentachlorophenol when the natural appearance of the wood must be retained and the treated wood requires a paint coating or other finish.[3]

3.1.2 Waterborne Preservatives

Standard wood preservatives used in water solution include acid copper chromate, ammoniacal copper arsenate, chromated copper arsenate (Types I, II, and III), chromated zinc chloride, and fluorchrome arsenate phenol. Waterborne preservatives leave the wood surface comparatively clean, paintable, and free from objecticnable odor. Typically, they must be used at low treating temperatures (100° to 150°F) because they are unstable at higher temperatures.[3]

The chromated zinc chloride and fluorchrome arsenate phenol formulations are not as leach resistant as other waterborne preservatives or oils and, therefore, are recommended for above-ground, light-duty uses only. The ammoniacal copper arsenate and chromated copper arsenate formulations are included in specifications for such items as building foundations, building poles, utility poles, marine piles, and piles for land and fresh water use.[3]

3.2 CONDITIONING TREATMENTS

With most wood treating methods, the presence of significant amounts of free water in the wood cell cavities may retard or even prevent the entrance of the preservative liquid.[7] Therefore, the moisture content of the wood must be reduced prior to treatment. Moisture reduction can be accomplished by using artificial conditioning treatments or by allowing the wood to air-season (i.e., storing the untreated wood outdoors in piles). Unseasoned wood that is exposed to the open air, but protected from rain, will gradually dry out until it comes into approximate equilibrium with the relative humidity of the air. Frequently, timbers must be treated without waiting for them to air-season because of unfavorable climatic conditions or because rush orders make it necessary to treat the wood immediately.[7]

Wood is conditioned by one of the following three primary methods: (1) steaming-and-vacuum, (2) boiling-under-vacuum (commonly referred to as the Boulton process), and (3) vapor drying. These conditioning treatments remove a substantial amount of moisture from the wood and also heat the wood to a more favorable treating temperature.[2] The steaming-and-vacuum process is employed mainly for southern pine, while the Boulton or boiling-under-vacuum process is used for Douglas fir and sometimes for hardwoods. Vapor drying is used for seasoning railroad ties and other products.[3]

3.2.1 Steaming-and-Vacuum Process

In the steaming process, the wood is steamed in the treating cylinder (retort) for several hours, usually at a maximum temperature of 245°F.[3] When the steaming is completed, a vacuum is immediately applied. During the steaming period, there is practically no reduction in the moisture content of the wood. In fact, some water actually is added by condensation in the early part of the steaming period when the wood is cold.[2]

When the steaming is discontinued and a vacuum is applied, the boiling point is lowered and part of the water in the wood, especially that near the surface, is forced out mechanically by the steam generated in the wood cells or is evaporated during the vacuum period. Most of the water removed by the vacuum after steaming is taken out during the early part of the vacuum period when the wood is hottest and evaporation is most rapid. From the standpoint of moisture removal, there is little need to continue the vacuum much longer than 2 hours.[2]

Among the principal advantages of steaming are: steam heats the wood faster than any of the other heating mediums; it is easily applied and requires no special equipment; the temperature can be controlled easily; and the wood is left clean after steaming is completed.[2]

The principal disadvantages are: wood surfaces are exposed to the actual steam temperature during the entire steaming period (which could damage temperature-sensitive woods); only a limited amount of moisture can be removed during the entire steaming period; and it is generally necessary to use considerably higher temperatures than would be needed, for example, in the use of the Boulton process.[2]

3.2.2 Boulton (Boiling-Under-Vacuum) Process

In the Boulton process, the treating cylinder is filled with hot preservative oil so that all the timbers are covered (although some unfilled space may be left above the oil surface). The preservative is then kept heated while a vacuum is applied. In this case, the oil serves to keep the wood hot while the vacuum lowers the boiling point of the water in the wood and causes part of the water to evaporate.[2] The evaporated moisture and some of the accompanying vapors from the oil pass through a condenser. The condensate can then be weighed or measured to determine how much water has been removed from the charge, and the volatile oils evaporated from the creosote and condensed with the water may be separated from the water and returned to the preservative tank.[2]

The vacuum during the boiling period usually reaches 22 inches or more, and the entire cycle may last anywhere from 10 to 36 hours. The average temperature of the preservative during the Boultonizing cycle typically ranges from 180° to 220°F depending upon the type of wood being treated and its intended use. This temperature range, lower than that of the steaming process, is a considerable advantage in treating woods that are especially susceptible to injury from high temperatures.[7] In general, the minimum, rather than the maximum, specified temperatures are used and the boiling period is only as long as is necessary to prepare the timber for subsequent impregnation of preservative.[7]

While originally intended for use with straight coal-tar creosote, the Boulton process also can be employed with creosote mixtures or any preservative oils that will not foam or cause problems during the conditioning period. The Boulton process is entirely unsuitable for waterborne preservatives, however, because the water in the solution would evaporate even more readily than that in the wood.[7]

The chief advantages of the Boulton process are: (1) milder temperatures are used (as compared to the steaming process) with minimum effect on the strength and on the physical condition of the wood, (2) the moisture content of the wood never increases, and (3) a greater moisture reduction can be obtained than is possible with the steaming process.[2]

The chief disadvantages of the Boulton process are that (1) it is suitable for oil-based preservatives only, (2) it often costs more than air-seasoning, (3) it heats the wood more slowly than steaming or boiling at high temperatures without vacuum, and (4) it usually requires a considerably longer time than the steaming-and-vacuum process.

3.2.3 Vapor-Drying Process

During the vapor-drying process, the wood in the treating cylinder is exposed to hot vapors produced by boiling an organic solvent, such as xylene; the vapors are then condensed. As condensation takes place, the latent heat of the solvent is given up and the moisture vaporizes. The resulting mixed vapors of water and the solvent are then passed through a condenser so the water can be separated and drained away and the solvent recovered and reused. The best results are obtained with solvents that have a boiling range of 280° to 320°F.[3]

3.3 PRESSURE PROCESSES

Most of the wood-preserving methods in use may be classified roughly as either pressure processes, in which the wood is placed in a treating cylinder or retort and impregnated with preservative under considerable force, or nonpressure processes, which are carried out without the use of induced pressure. In nonpressure processes, the preservative is applied to the wood by brushing or spraying or by dipping, soaking, or steeping the wood in the preservative. However, the majority of wood treated annually is impregnated by pressure methods in closed cylinders.[7] Therefore, only pressure processes are discussed in the following sections.

Pressure processes differ in details, but the general principle is the same. The treatment is carried out in steel cylinders or retorts, most within the limits of 6 to 9 feet in diameter and up to 150 feet or more in length and are built to withstand working pressures up to 250 psi.[7] The wood is loaded on special tram cars and run into the retort, which is then closed and filled with preservative. Applied pressure forces preservative into the wood until the desired amount has been absorbed. Three processes, the full-cell, modified full-cell, and empty-cell, are in common use.

3.3.1 Full-Cell Process

The full-cell (Bethel) process is used when the retention of a maximum quantity of preservative is desired. Timbers typically are treated full-cell with creosote when protection against marine borers is required. Waterborne preservatives are generally applied by the full-cell process, and control over preservative retention is obtained by regulating the concentration of the treating solution.[3]

Steps in the full-cell process are listed below:

1. The charge of wood is sealed in the treating cylinder, and a preliminary vacuum is applied for 0.5 hour or more to remove the air from the cylinder and as much as possible from the wood.
2. The preservative, at ambient or elevated temperature depending on the system, is admitted to the cylinder without breaking the vacuum.
3. After the cylinder is filled, pressure is applied until the wood will take no more preservative or until the required retention of preservative is obtained.
4. When the pressure period is completed, the preservative is withdrawn from the cylinder.
5. A short final vacuum may be applied to minimize dripping of preservative from the charge.[3]

When the wood is steamed before treatment, the preservative is admitted at the end of the vacuum period that follows steaming. When the timber has received preliminary conditioning by the Boulton or boiling-under-vacuum process, the cylinder can be filled and the pressure applied as soon as the conditioning period is completed.[3]

3.3.2 Modified Full-Cell Process

The modified full-cell process is basically the same as the full-cell process except for the amount of initial vacuum. The modified full-cell process uses lower levels of vacuum; the actual amount is determined by the wood species and the final retention desired. This process is used only on material 2 inches or less in thickness.[3]

3.3.3 Empty-Cell Process

The objective of empty-cell treatment is to obtain deep penetration with a relatively low net retention of preservative. For treatment with oil preservatives, the empty-cell process should always be used if it will provide the desired retention. Two empty-cell processes, the Rueping and the Lowry, are commonly employed; both use the expansive force of compressed air to drive out part of the preservative absorbed during the pressure period.[3]

3.3.3.1 Rueping Process. The Rueping empty-cell process has been widely used for many years in both Europe and the United States. The following general procedure is employed:

1. Air under pressure is forced into the treating cylinder, which contains the charge of wood. The air penetrates some species easily, requiring but a few minutes' application of pressure. In the treatment of the more resistant species, common practice is to maintain air pressure from ½ to 1 hour before admitting the preservative, but the necessity for long air-pressure periods does not seem fully established. The air pressures employed generally range between 25 and 100 psi depending on the net retention of preservative desired and the resistance of the wood.

2. After the period of preliminary air pressure, preservative is forced into the cylinder. As the preservative is pumped in, the air escapes from the treating cylinder into an equalizing or Rueping tank at a rate that keeps the pressure constant within the cylinder. When the treating cylinder is filled with preservative, the treating pressure is raised above that of the initial air and is maintained until the wood will take no more preservative, or until enough has been absorbed to leave the required retention of preservative in the wood after the treatment.

3. At the end of the pressure period, the preservative is drained from the cylinder, and surplus preservative is removed from the wood with a final vacuum. The amount recovered may be from 20 to 60 percent of the gross amount injected.[3]

3.3.3.2 Lowry Process. The Lowry process is often called the empty-cell process without initial air pressure. Preservative is admitted to the cylinder without either an initial air pressure or a vacuum, and the air originally in the wood at atmospheric pressure is imprisoned during the filling period. After the cylinder is filled with the preservative, pressure is applied, and the remainder of the treatment is the same as described for the Rueping treatment.[3]

The Lowry process has the advantage that equipment for the full-cell process can be used without other accessories; the Rueping process usually requires additional equipment, such as an air compressor and an extra cylinder or Rueping tank for the preservative, or a suitable pump to force the preservative into the cylinder against the air pressure. Both processes, however, are widely and successfully used.[3]

4.0 AIR EMISSIONS AND CONTROLS

The operation of equipment used for treating wood with creosote solutions results in the emission of odor-causing air contaminants and possible air toxics. For the purposes of this study, it was not possible to quantify emissions. However, a Toxic Chemical Release Inventory Reporting Form (EPA Form R) completed by Koppers' Salem, Virginia, facility in compliance with Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 was obtained and is presented in Appendix A. Koppers reported emissions of the following in 1987:

	Annual emissions, lb/yr	
	Fugitive	Stack
Biphenyl	280	10
Dibenzofuran	640	10
Anthracene	730	4
Naphthalene	5,900	480

The primary sources of emissions and odor have been identified as:

1. The treated charge immediately after removal from the retort;
2. The vacuum system; and
3. Displaced air from working tank blow backs;

Information found in the literature and observations made during plant visits (see Appendix B) aided in identifying the above sources.

4.1 TREATED CHARGE

One source reports that emissions from treated wood immediately after removal from the retort usually exceed 60 percent opacity beyond the opaque water vapor breakoff point and continue to exceed 40 percent opacity for up to 20 minutes.[8] Heat from the treated charge causes some of the lower boiling organic compounds to volatilize as aerosols, forming a dense white emission plume. Emissions of 60 percent opacity or more beyond the opaque steam plume from the open end of the retort continue only during the few minutes it takes to remove the treated wood and recharge the retort.[8] However, during a recent visit to one facility it was noted that a charge pulled 14 hours earlier was still showing evidence of visible emissions and odor (see Appendix B - Koppers trip report).

Several techniques for controlling fugitive emission losses from treated charges have been suggested with varying degrees of success. One approach is to construct a ventilation hood or building to collect organic vapors coming off the charge. The hood would need to cover the entire end of the retort, a section of track and switches, and a complete tram or trams. Such a structure, perhaps exceeding 150 feet in length, would require enormous gas exhaust rates, and the associated emission control devices would also be very large. Such hooding and ventilation systems could be economically unfeasible for the retrofit of existing uncontrolled plants.[8]

Low boiling point organics may be controlled by reducing the temperature of the freshly treated wood. To drop the temperature of the wood, heat must be conducted and/or convected out of the wood. Fourier's equation provides the basic relationship that describes steady-state heat conduction.

$$q = kA \frac{dt}{dx}$$

where:

q = heat conduction in x direction, Btu/h
A = cross-sectional area normal to heat flow, ft^2
dt/dx = temperature gradient in x direction, °F/ft
k = thermal conductivity of conducting medium, Btu/h•ft•°F

The thermal conductivities of water and air at 32°F are reported as 0.343 and 0.0140, respectively.[9] Thermal conductivity is moderately dependent on temperature. Nonetheless, the thermal conductivity of water is between 20 and 25 times greater than the thermal conductivity of air in the temperature range of 32° to 200°F. Thus, water will cool the wood ties faster than air.

Two processes aimed at cooling the freshly treated ties using water have been demonstrated. In the first, a manifold containing spray nozzles is mounted a few centimeters from the open end of the retort. The nozzles are positioned to blanket the entire opening and emerging charge with water sprayed at about 300 gallons/minute as the charge is slowly pulled from the retort (no faster than 17 feet per minute).[8] In theory, the water spray will cool the ties and scrub and condense the escaping vapors. In reality, this method has enjoyed limited success. While controlling some of the initial vapors, the water spray actually does very little to cool the ties. The ties that are stacked in the center are not subjected to the spray so the charge as a whole is not significantly cooled.

The second process involves using water to quench the ties while still in the retort. Following the final vacuum and before the retort door is opened to remove the treated ties, the retort is filled with water to quench the ties. The water is then emptied and the ties are removed. This water quench cycle may have to be repeated or be designed with a circulating water system if the void volume in the retort is not great enough to allow sufficient cooling water into the retort to cool the ties. This system has been demonstrated to be successful in controlling emissions from a plant treating approximately 430 air-dried ties per charge with a void volume of approximately 15,000 gallons (see Appendix B - Jennison-Wright trip report).

One obvious drawback to these two methods is that the contaminant is merely transferred from the air to the water, resulting in the need for treatment of an additional effluent stream. Facilities using these methods to cool the ties will recycle the water and remove the insolubles periodically. A cooling system or a large-capacity water system will be needed to keep cooling water temperatures low to maintain the effectiveness of the quenching system.

4.2 VACUUM SYSTEM

During the Boulton process and the final vacuum applied during the Rueping process, volatile organics are evaporating from the creosote solution and exiting the retort through the vacuum system. In the two plants visited, one plant uses a reciprocating vacuum pump while the other uses a steam jet ejector to induce a vacuum of 22 to 24 inches of mercury on the retort. Both plants have a single-pass, water-cooled condenser in line between the vacuum source and the retort to condense the vapors.

Koppers uses two steam jet ejectors to induce the vacuum on the retorts. A 4-inch steam jet is used to draw the system pressure down to between 22 and 24 inches of mercury, usually taking between 1 and 2 hours. Ideally, once the vacuum has been obtained, the operator will switch over to a 2-inch steam jet to maintain the vacuum for the remainder of the cycle to save energy. However, during periods of high steam demand there may not be enough steam available from the plant's boiler to maintain a 24-inches (mercury) vacuum using the 2-inch steam jet. Therefore, the 4-inch steam jet may remain on during the entire vacuum cycle if the steam demand (i.e., heat for retorts, working tanks, buildings, etc.) for the rest of the plant is high.

Odors emanating from the steam jet suggest that the single-pass, water-cooled condenser may not be capable of condensing all of the organics, allowing them to become entrained in the steam jet. There are several possible solutions to eliminate this odor. The first is to install a larger condenser capable of reducing the organic content in the vapor further. Secondly, the vacuum system can be modified to include two steam jet ejectors in series with a barometric (direct contact) intercondenser between them. In this type of ejector system, the barometric intercondensers condense the oily vapors entrained in the steam and flush them out with the intercondensed water.[10] A third option would be to replace the steam jet ejectors with a vacuum pump and route the exhaust vapors to an activated carbon adsorption system or to an afterburner. Both are extremely efficient methods to remove organics from the exhaust gas.

The steam jet ejectors should not be used with the latter two control options. Water may preferentially adsorb onto carbon in the activated carbon system and impede the diffusion of organics into the pore spaces. The steam jets also will generate a larger volume of gas to be treated by either method and lower the average Btu value of the steam, which is a factor to consider if an afterburner is used.

Incineration of air contaminants in an afterburner is a proven method for controlling emissions during the operation of the vacuum cycle.[8] The volume of the contaminated gaseous effluent varies from about 300 to 1,200 scfm. Precautions should be taken to keep gas velocities well above flame propagation velocities to prevent flashback. This can be accomplished by narrowing the throat diameter leading into the afterburner. The afterburner should be designed for an exit temperature of 1500°F and a retention time of 0.3 seconds or more in the combustion zone.[8] Source tests have shown afterburner efficiencies of 99 percent when operated at 1400°F exit temperature.[9]

Studies have shown that afterburner operating costs can be reduced by recovering the heat from the afterburner exhaust gases. A shell-and-tube heat exchanger can be installed at the outlet from the afterburner to heat boiler feed water or to supplement the steam producing facilities of the wood-treating plant.

4.3 WORKING TANK BLOW BACKS

A working tank blow back event occurs when, at the end of a treatment cycle, the creosote solution is sent back to the work tanks. The air displaced by the filling of the work tanks is at equilibrium with the preservative in the tank. If 30,000 gallons of preservative fill each retort, as is the case with Koppers, then approximately 4,000 cubic feet of air are displaced when the solution is sent back to the work tanks. Each of the two plants visited use a water scrubber system to control blow back vapors. The vapors are bubbled through water and/or brought into contact with a water spray and vented to the atmosphere. The effectiveness of these systems as scrubbers would be expected to approach zero if the water is allowed to reach saturation and is not changed periodically.

Another option for controlling blow back vapors is to incinerate them in an afterburner. It is worth noting that in the Koppers and Jennison-Wright treatment process, a vacuum cycle always follows a blow back to the work tanks. As discussed in the previous section regarding the control of vacuum system vapors, an afterburner is a proven method of controlling emissions during the operation of the vacuum system.

It should be possible to control blow back vapors by firing the afterburner 15 minutes earlier (the approximate time needed to empty the retort) and ducting the blow back vapors to the afterburner. Immediately after the blow back, the vacuum system is cut on and the exhaust vapors are ducted to the afterburner. During the Boultonizing cycle, the afterburner will be controlling vapors from the vacuum system and from the blow back simultaneously.

During blow backs, Koppers indicated that it uses pressure built up in the retort to force the preservative back up through the bottom of the work tank. Problems arise when an operator does not closely monitor how much preservative is being blown back and begins to blow air up through the working tanks. Air bubbled up through the work tanks picks up volatile material and carries it out the vent. This scenario can be prevented by emptying the retorts using a centrifugal pump.[10]

5.0 CONCLUSIONS

The operation of equipment used for treating wood with creosote solutions results in the emission of odor-causing air contaminants and possible air toxics. Information found in the literature and observations made during plant visits suggest that there are three primary sources of air emissions at creosote wood treatment plants. Table 8 lists these emission sources and the available techniques demonstrated to control them.

At this time, no reliable quantitative estimates of emissions from these sources or possible emission reductions from the respective control devices have been made. Koppers has quantified and reported emissions of biphenyl, dibenzofuran, anthracene, and naphthalene in its 1987 Toxic Chemical Release Inventory Reporting Form (Appendix A) totaling over 8,000 pounds per year. Approximately 80 percent of the emissions were reported as naphthalene.

As a result of the plant visits to Koppers and Jennison-Wright, information is available to compare and contrast the two facilities and make qualitative assessments of emissions. Table 9 presents a comparison and contrast of the two plants and the methods and practices used to treat their respective charges. In order to establish a baseline for comparison, it is worth noting that both plants are treating railroad ties for the same customer (Norfolk & Southern) to the same target retention of preservative (about 8 lb/ft^3), and using the same 60/40 creosote/coal tar preservative solution. However, the plants differ in several respects. The most noteworthy of these is that Koppers treats mostly unseasoned ties and Jennison-Wright treats only air-dried (seasoned) ties. As a result, Koppers has a much longer treatment cycle because it must Boultonize the ties to remove moisture from the sapwood of the charge.

The Boulton cycle used by Koppers to condition unseasoned ties may significantly increase the odor or air toxic release over that of a facility treating seasoned ties not requiring moisture removal. The following two process conditions clearly support this suggestion. First, the Koppers process has a treatment time of approximately 24 hours, which is two to three times longer than the time required at Jennison-Wright.

TABLE 8. EMISSION SOURCES AND DEMONSTRATED EMISSION CONTROL TECHNOLOGIES

Source	Control
Freshly treated charge	• Water spray • Water quench
Vacuum system	• Condenser(s) • Afterburner • Carbon adsorber
Working tank blow backs	• Water scrubber • Afterburner • Carbon adsorber

TABLE 9. COMPARISON AND CONTRAST OF KOPPERS AND JENNISON-WRIGHT WOOD TREATMENT PROCESSES

Koppers	Jennison-Wright
• Customer: Norfolk and Southern Railroad	• Norfolk and Southern Railroad
• Treats green unseasoned ties	• Treats air-dried ties
• Treats 3,000 ties per day	• Production rate is confidential
• 2,670 ft^3 of wood per charge	• 1,146 ft^3 of wood per charge
• 4,370 ft^3 of void space in retort	• 2,005 ft^3 of void space in retort
• 0.61 ft^3 of wood per ft^3 of void space	• 0.57 ft^3 of wood per ft^3 of void space
• Employs Boulton and Rueping process	• Employs Rueping process
• Treatment temperature 200°F	• Treatment temperature: 205°F
• Uses 60/40 creosote/coal tar mixture	• Uses 60/40 creosote/coal tar mixture
• Preservative contains 3 percent naphthalene	• Preservative contains 7 to 9 percent naphthalene
• Target retention of 7 to 8 lb creosote/ft^3 wood	• Target retention of 8 lb creosote/ft^3 wood
• Approximate 24-hour treatment cycle	• 8 to 10 hour treatment cycle
• 16 to 18 hour vacuum cycle	• 1 hour vacuum cycle
• Vacuum source: 4-inch steam jet ejector	• Reciprocating vacuum pump
• Vacuum system vapor control: single-pass condenser	• Single-pass condenser
• 2 blow backs per treatment cycle	• 1 blow back per treatment cycle
• 20,000-gallon blow back vapor scrubber	• 500,000-gallon blow back vapor scrubber
• No tie quenching system	• Water introduced into retort to quench ties

The extended treatment time is the result of the addition of the 16 to 18 hour Boulton cycle. The vacuum system, identified as a major emission source, runs continuously during the Boulton cycle. The extended operation of this emission source creates a greater potential for the release of odor and air toxics.

Secondly, the Boulton cycle results in an additional blow back of preservative to the work tanks. This increases, perhaps doubles, the potential for odor and air toxics to be emitted. As presented in Table 9, although Koppers has twice the number of blow backs and approximately twice the void volume in the retort (measure of how much preservative is transferred to and from the working tanks) as Jennison-Wright, Koppers' 20,000 gallon water scrubber system is 25 times smaller than that of Jennison-Wright. A qualitative assessment suggests that a substantially higher potential for emissions during blow back periods exists at Koppers.

A final comparison from Table 9 shows that the volume of wood per volume of void space is approximately the same for the two plants. Koppers has slightly less void space per cubic foot of wood in and around the charge (about 7 percent less). This suggests that Koppers may be able to quench and cool the ties in a manner similar to Jennison-Wright. However, the Koppers charge did appear hotter than the Jennison-Wright charge (before quenching) and may require more cooling water to appreciably lower the temperature of the charge.

6.0 REFERENCES

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APPENDIX A.

TOXIC CHEMICAL RELEASE INVENTORY REPORTING FORM--KOPPERS

Form Approved OMB No.: 2070-0093
Approval Expires: 01/91
Page 1 of 5

(Important: Type or print; read instructions before completing form.)

U.S. Environmental Protection Agency

SEPA TOXIC CHEMICAL RELEASE INVENTORY REPORTING FORM

EPA FORM
R

Section 313, Title III of The Superfund Amendments and Reauthorization Act of 1986

(This space for EPA use only.)

PART I. FACILITY IDENTIFICATION INFORMATION

13-87-01054586-9-VP

1\. 1.1 Does this report contain trade secret information?
☐ Yes (Answer 1.2) ☑ No (Do not answer 1.2)

1.2 Is this a sanitized copy? ☐ Yes ☐ No

1.3 Reporting Year: 1987

2. CERTIFICATION (Read and sign after completing all sections.)

I hereby certify that I have reviewed the attached documents and that, to the best of my knowledge and belief, the submitted information is tr and complete and that the amounts and values in this report are accurate based on reasonable estimates using data available to the preparers of this report.

Name and official title of owner/operator or senior management official: James R. Batchelder, Vice President & Manager, Technical & Environmental Ser Tar & Wc

Signature: James R Batchelder

Date signed: 6/30/88

3. FACILITY IDENTIFICATION

3.1 Facility or Establishment Name: Koppers Company, Inc.
Street Address: Rt. 460
City: Salem
County: Roanoke
State: Virginia
Zip Code: 24153

3.2 This report contains information for: (check one)
a. ☑ An entire covered facility.
b. ☐ Part of a covered facility.

3.3 Technical Contact: Robert Anderson
Telephone Number (include area code): (412) 227-2683

3.4 Public Contact: Mark A. Franck
Telephone Number (include area code): (703) 380-2061

3.5 SIC Code: a. 2491 b. N/A c. N/A

3.6 Latitude: Deg. 037 Min. 15 Sec. 00
Longitude: Deg. 080 Min. 07 Sec. C0

3.7 Dun & Bradstreet Number(s): a. 00-312-5770 b. N/A

3.8 EPA Identification Number (RCRA I.D. No.): a. VAD003125770 b. N/A

3.9 NPDES Permit Number(s): a. VA0001333 b. N/A

3.10 Name of Receiving Stream(s) or Water Body(s):
a. Roanoke River to Roanoke River Basin to Roanoke River Subbasin
b. N/A
c. N/A

3.11 Underground Injection Well Code (UIC) Identification No.: N/A

Where to send completed forms:

U.S. Environmental Protection Agency
P.O. Box 70266
Washington, DC 20024-0266
Attn: Toxic Chemical Release Inventory

4. PARENT COMPANY INFORMATION

4.1 Name of Parent Company: N/A

4.2 Parent Company's Dun & Bradstreet No.: N/A

JUL 13 1988

278373

(Important: Type or print; read instructions before completing form.)

Page 2 of 5

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EPA FORM R
PART II. OFF-SITE LOCATIONS TO WHICH TOXIC CHEMICALS ARE TRANSFERRED IN WASTES

1. PUBLICLY OWNED TREATMENT WORKS (POTW)

Facility Name N/A

Street Address

City | County

State | Zip | | | | | -| | | |

2. OTHER OFF-SITE LOCATIONS - Number these locations sequentially on this and any additional page of this form you us

☐ **Other off-site location** N/A

EPA Identification Number (RCRA ID. No.)

Facility Name

Street Address

City | County

State | Zip | | | | | -| | | |

Is location under control of reporting facility or parent company? ☐ Yes ☐ No

☐ **Other off-site location**

EPA Identification Number (RCRA ID. No.)

Facility Name N/A

Street Address

City | County

State | Zip | | | | | -| | | |

Is location under control of reporting facility or parent company? ☐ Yes ☐ No

☐ **Other off-site location**

EPA Identification Number (RCRA ID. No.)

Facility Name N/A

Street Address

City | County

State | Zip | | | | | -| | | |

Is location under control of reporting facility or parent company? ☐ Yes ☐ No

278374

☐ Check if additional pages of Part II are attached.

portant; Type or print; read instructions before completing form.)

Page 3 of 5

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EPA FORM R

PART III. CHEMICAL SPECIFIC INFORMATION

1. CHEMICAL IDENTITY

1.1 ☐ Trade Secret (Provide a generic name in 1.4 below. Attach substantiation form to this submission.)

1.2 CAS # 000091-20-3 (Use leading zeros if CAS number does not fill space provided.)

1.3 Chemical or Chemical Category Name: Naphthalene

1.4 Generic Chemical Name (Complete only if 1.1 is checked.)

2. MIXTURE COMPONENT IDENTITY (Do not complete this section if you have completed Section 1.)

2. Generic Chemical Name Provided by Supplier (Limit the name to a maximum of 70 characters (e.g., numbers, letters, spaces, punctuation)).

3. ACTIVITIES AND USES OF THE CHEMICAL AT THE FACILITY (Check all that apply.)

3.1 Manufacture:
- a. ☐ Produce
- b. ☐ Import
- c. ☐ For on-site use/processing
- d. ☐ For sale/distribution
- e. ☐ As a byproduct
- f. ☐ As an impurity

3.2 Process:
- a. ☐ As a reactant
- b. ☐ As a formulation component
- c. ☑ As an article component
- d. ☐ Repackaging only

3.3 Otherwise Used:
- a. ☐ As a chemical processing aid
- b. ☐ As a manufacturing aid
- c. ☐ Ancillary or other use

4. MAXIMUM AMOUNT OF THE CHEMICAL ON SITE AT ANY TIME DURING THE CALENDAR YEAR

05 (enter code)

5. RELEASES OF THE CHEMICAL TO THE ENVIRONMENT

You may report releases of less than 1,000 lbs. by checking ranges under A.1.		A. Total Release (lbs/yr) A.1 Reporting Ranges 0	1–499	500–999	A.2 Enter Estimate	B. Basis of Estimate (enter code)	C. % From Stormwater
5.1 Fugitive or non-point air emissions	5.1a				5900	5.1b E	
5.2 Stack or point air emissions	5.2a				480	5.2b E	
5.3 Discharges to water (Enter letter code from Part I Section 3.10 for stream(s).) 5.3.1 a	5.3.1a				14	5.3.1b ☐	5.3.1c N/D
5.3.2 ☐	5.3.2a				N/A	5.3.2b ☐	5.3.2c
5.3.3 ☐	5.3.3a				N/A	5.3.3b ☐	5.3.3c
5.4 Underground injection	5.4a				N/A	5.4b ☐	
5.5 Releases to land 5.5.1 D919 (enter code)	5.5.1a				390	5.5.1b M	
5.5.2 D005 (enter code)	5.5.2a				1400	5.5.2b O	
5.5.3 ☐ (enter code)	5.5.3a				N/A	5.5.3b ☐	

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☐ (Check if additional information is provided on Part IV–Supplemental Information.)

EPA Form 9350-1(1-88)

6. TRANSFERS OF THE CHEM IN WASTE TO OFF-SITE LOCATIONS

You may report transfers of less than 1,000 lbs. by checking ranges under A.1.		A. Total Transfers (lbs/yr) A.1 Reporting Ranges 0	1-499	500-999	A.2 Enter Estimate	B. Basis of Estimate (enter code)	C. Type of Treatment/ Disposal (enter code)
6.1 Discharge to POTW		☐	☐	☐	N/A	6.1b ☐	
6.2 Other off-site location (Enter block number from Part II, Section 2.)	☐	☐	☐	☐	N/A	6.2b ☐	6.2c ☐☐☐
6.3 Other off-site location (Enter block number from Part II, Section 2.)	☐	☐	☐	☐	N/A	6.3b ☐	6.3c ☐☐☐
6.4 Other off-site location (Enter block number from Part II, Section 2.)	☐	☐	☐	☐	N/A	6.4b ☐	6.4c ☐☐☐

☐ (Check if additional information is provided on Part IV-Supplemental Information)

7. WASTE TREATMENT METHODS AND EFFICIENCY

A. General Wastestream (enter code)	B. Treatment Method (enter code)	C. Range of Influent Concentration (enter code)	D. Sequential Treatment? (check if applicable)	E. Treatment Efficiency Estimate	F. Based on Operating Data? Yes	No
7.1a W	7.1b B11	7.1c 4	7.1d ☐	7.1e 99 %	7.1f ☐	☑
7.2a ☐	7.2b N/A	7.2c ☐	7.2d ☐	7.2e %	7.2f ☐	☐
7.3a ☐	7.3b ☐☐☐	7.3c ☐	7.3d ☐	7.3e %	7.3f ☐	☐
7.4a ☐	7.4b ☐☐☐	7.4c ☐	7.4d ☐	7.4e %	7.4f ☐	☐
7.5a ☐	7.5b ☐☐☐	7.5c ☐	7.5d ☐	7.5e %	7.5f ☐	☐
7.6a ☐	7.6b ☐☐☐	7.6c ☐	7.6d ☐	7.6e %	7.6f ☐	☐
7.7a ☐	7.7b ☐☐☐	7.7c ☐	7.7d ☐	7.7e %	7.7f ☐	☐
7.8a ☐	7.8b ☐☐☐	7.8c ☐	7.8d ☐	7.8e %	7.8f ☐	☐
7.9a ☐	7.9b ☐☐☐	7.9c ☐	7.9d ☐	7.9e %	7.9f ☐	☐
7.10a ☐	7.10b ☐☐☐	7.10c ☐	7.10d ☐	7.10e %	7.10f ☐	☐
7.11a ☐	7.11b ☐☐☐	7.11c ☐	7.11d ☐	7.11e %	7.11f ☐	☐
7.12a ☐	7.12b ☐☐☐	7.12c ☐	7.12d ☐	7.12e %	7.12f ☐	☐
7.13a ☐	7.13b ☐☐☐	7.13c ☐	7.13d ☐	7.13e %	7.13f ☐	☐
7.14a ☐	7.14b ☐☐☐	7.14c ☐	7.14d ☐	7.14e %	7.14f ☐	☐

☐ (Check if additional information is provided on Part IV-Supplemental Information.)

8. OPTIONAL INFORMATION ON WASTE MINIMIZATION

(Indicate actions taken to reduce the amount of the chemical being released from the facility. See the instructions for coded items and an explanation of what information to include.)

A. Type of modification (enter code)	B. Quantity of the chemical in the wastestream prior to treatment/disposal: Current reporting year (lbs/yr)	Prior year (lbs/yr)	Or percent change	C. Index	D. Reason for action (enter code)
☐☐			%	☐.☐	☐☐

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EPA Form 9350-1(1-88)

(Important: Type or print; rea [illegible]structions before completing form.)

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EPA FORM R
PART IV. SUPPLEMENTAL INFORMATION

Use this section if you need additional space for answers to questions in Parts I and III. Number or letter this information sequentially from prior sections (e.g., D.E. F. or 5.54, 5.55).

ADDITIONAL INFORMATION ON FACILITY IDENTIFICATION (Part I - Section 3)

3.5	SIC Code		
3.7	Dun & Bradstreet Number(s)		
3.8	EPA Identification Number(s) RCRA I.D. No.)		
3.9	NPDES Permit Number(s)		
3.10	Name of Receiving Stream(s) or Water Body(s)		

ADDITIONAL INFORMATION ON RELEASES TO LAND (Part III - Section 5.5)

Releases to Land		A. Total Release (lbs/yr)				B. Basis of Estimate (enter code)
		A.1 Reporting Ranges			A.2 Enter Estimate	
		0	1-499	500-999		
5.5___ ☐☐☐ (enter code)	5.5___a					5.5___b ☐
5.5___ ☐☐☐ (enter code)	5.5___a					5.5___b ☐
5.5___ ☐☐☐ (enter code)	5.5___a					5.5___b ☐

ADDITIONAL INFORMATION ON OFF-SITE TRANSFER (Part III - Section 6)

		A. Total Transfers (lbs/yr)				B. Basis of Estimate (enter code)	C. Type of Treatment/ Disposal (enter code)
		A.1 Reporting Ranges			A.2 Enter Estimate		
		0	1-499	500-999			
6.___ Discharge to POTW	6.___a					6.___b ☐	
6.___ Other off-site location (Enter block number from Part II, Section 2.) ☐	6.___a					6.___b ☐	6.___c ☐☐☐
6.___ Other off-site location (Enter block number from Part II, Section 2.) ☐	6.___a					6.___b ☐	6.___c ☐☐☐

ADDITIONAL INFORMATION ON WASTE TREATMENT (Part III - Section 7)

A. General Wastestream (enter code)	B. Treatment Method (enter code)	C. Range of Influent Concentration (enter code)	D. Sequential Treatment? (check if applicable)	E. Treatment Efficiency Estimate	F. Based on Operating Data?	
					Yes	No
7.___a ☐	7.___b ☐☐☐	7.___c ☐	7.___d ☐	7.___e %	7.___f ☐	☐
7.___a ☐	7.___b ☐☐☐	7.___c ☐	7.___d ☐	7.___e %	7.___f ☐	☐
7.___a ☐	7.___b ☐☐☐	7.___c ☐	7.___d ☐	7.___e %	7.___f ☐	☐
7.___a ☐	7.___b ☐☐☐	7.___c ☐	7.___d ☐	7.___e %	7.___f ☐	☐
7.___a ☐	7.___b ☐☐☐	7.___c ☐	7.___d ☐	7.___e %	7.___f ☐	☐

Form Approved OMB No.: 2070-0093
Approval Expires: 01/91
Page 1 of 5

(Important: Type or print; read instructions before completing form.)

U.S. Environmental Protection Agency

EPA TOXIC CHEMICAL RELEASE INVENTORY REPORTING FORM

Section 313, Title III of The Superfund Amendments and Reauthorization Act of 1986

EPA FORM **R**

PART I. FACILITY IDENTIFICATION INFORMATION

13-87-01054387-1-VA

1.

1.1 Does this report contain trade secret information? ☐ Yes (Answer 1.2) ☑ No (Do not answer 1.2)

1.2 Is this a sanitized copy? ☐ Yes ☐ No

1.3 Reporting Year: 1987

2. CERTIFICATION (Read and sign after completing all sections.)

I hereby certify that I have reviewed the attached documents and that, to the best of my knowledge and belief, the submitted information is true and complete and that the amounts and values in this report are accurate based on reasonable estimates using data available to the preparers of this report.

Name and official title of owner/operator or senior management official: James R. Batchelder, Vice President - Manager, Technical - Environmental Ser. Tar + Wo

Signature: James R Batchelder

Date signed: 6/30/88

3. FACILITY IDENTIFICATION

3.1 Facility or Establishment Name: Koppers Company, Inc.
Street Address: Rt. 460
City: Salem
County: Roanoke
State: Virginia
Zip Code: 24153

3.2 This report contains information for: (check one)
a. ☑ An entire covered facility.
b. ☐ Part of a covered facility.

3.3 Technical Contact: Robert Anderson
Telephone Number (include area code): (412) 227-2683

3.4 Public Contact: Mark A. Franck
Telephone Number (include area code): (703) 380-2061

3.5 SIC Code: a. 2491 b. N/A c. N/A

3.6 Latitude: Deg. 037 Min. 15 Sec. 00 Longitude: Deg. 080 Min. 07 Sec. 00

3.7 Dun & Bradstreet Number(s): a. 01-312-5770 b. N/A

3.8 EPA Identification Number (RCRA I.D. No.): a. VAD003125770 b. N/A

3.9 NPDES Permit Number(s): a. VA0001333 b. N/A

3.10 Name of Receiving Stream(s) or Water Body(s):
a. Roanoke River to Roanoke River Basin to Roanoke River Subbasin
b. N/A
c. N/A

3.11 Underground Injection Well Code (UIC) Identification No.: N/A

Where to send completed forms:

U.S. Environmental Protection Agency
P.O. Box 70266
Washington, DC 20024-0266
Attn: Toxic Chemical Release Inventory

4. PARENT COMPANY INFORMATION

4.1 Name of Parent Company: N/A

4.2 Parent Company's Dun & Bradstreet No.: N/A

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EPA Form 9350-1 (1-88)

(Important: Type or print; read instructions before completing form.)

(This space for EPA use only.)

EPA FORM R
PART II. OFF-SITE LOCATIONS TO WHICH TOXIC CHEMICALS ARE TRANSFERRED IN WASTES

1. PUBLICLY OWNED TREATMENT WORKS (POTW)

Facility Name N/A

Street Address

City

County

State

Zip

2. OTHER OFF-SITE LOCATIONS - Number these locations sequentially on this and any additional page of this form you us

☐ **Other off-site location** N/A

EPA Identification Number (RCRA ID. No.)

Facility Name

Street Address

City

County

State

Zip

Is location under control of reporting facility or parent company? ☐ Yes ☐ No

☐ **Other off-site location**

EPA Identification Number (RCRA ID. No.)

Facility Name N/A

Street Address

City

County

State

Zip

Is location under control of reporting facility or parent company? ☐ Yes ☐ No

☐ **Other off-site location**

EPA Identification Number (RCRA ID. No.)

Facility Name N/A

Street Address

City

County

State

Zip

Is location under control of reporting facility or parent company? ☐ Yes ☐ No

☐ Check if additional pages of Part II are attached.

(Important: Type or print; read instructions before completing form.)

(This space for EPA use only.)

EPA FORM R

PART III. CHEMICAL SPECIFIC INFORMATION

1. CHEMICAL IDENTITY

1.1 ☐ Trade Secret (Provide a generic name in 1.4 below. Attach substantiation form to this submission.)

1.2 CAS # 120-12-7 (Use leading zeros if CAS number does not fill space provided.)

1.3 Chemical or Chemical Category Name: Anthracene

1.4 Generic Chemical Name (Complete only if 1.1 is checked.)

2. MIXTURE COMPONENT IDENTITY (Do not complete this section if you have completed Section 1.)

Generic Chemical Name Provided by Supplier (Limit the name to a maximum of 70 characters (e.g., numbers, letters, spaces, punctuation)).

3. ACTIVITIES AND USES OF THE CHEMICAL AT THE FACILITY (Check all that apply.)

3.1 Manufacture:
- a. ☐ Produce
- b. ☐ Import
- c. ☐ For on-site use/processing
- d. ☐ For sale/distribution
- e. ☐ As a byproduct
- f. ☐ As an impurity

3.2 Process:
- a. ☐ As a reactant
- b. ☐ As a formulation component
- c. ☑ As an article component
- d. ☐ Repackaging only

3.3 Otherwise Used:
- a. ☐ As a chemical processing aid
- b. ☐ As a manufacturing aid
- c. ☐ Ancillary or other use

4. MAXIMUM AMOUNT OF THE CHEMICAL ON SITE AT ANY TIME DURING THE CALENDAR YEAR

04 (enter code)

5. RELEASES OF THE CHEMICAL TO THE ENVIRONMENT

You may report releases of less than 1,000 lbs. by checking ranges under A.1.		A. Total Release (lbs/yr) A.1 Reporting Ranges 0	1–499	500–999	A.2 Enter Estimate	B. Basis of Estimate (enter code)		
5.1 Fugitive or non-point air emissions	5.1a				736	5.1b	E	
5.2 Stack or point air emissions	5.2a				4	5.2b	E	
5.3 Discharges to water (Enter letter code from Part I Section 3.10 for stream(s).) 5.3.1 a	5.3.1a				0	5.3.1b		C. % From Stormwater 5.3.1c N.D.
5.3.2	5.3.2a				N/A	5.3.2b		5.3.2c
5.3.3	5.3.3a				N/A	5.3.3b		5.3.3c
5.4 Underground injection	5.4a				N/A	5.4b		
5.5 Releases to land 5.5.1 D99 (enter code)	5.5.1a			-	140	5.5.1b	M	
5.5.2 D05 (enter code)	5.5.2a				180	5.5.2b	O	
5.5.3 (enter code)	5.5.3a				N/A	5.5.3b		278380

☐ (Check if additional information is provided on Part IV–Supplemental Information.)

6. TRANSFERS OF THE CHEM[illegible] IN WASTE TO OFF-SITE LOCATIONS

You may report transfers of less than 1,000 lbs. by checking ranges under A.1.		A. Total Transfers (lbs/yr) A.1 Reporting Ranges 0	1–499	500–999	A.2 Enter Estimate	B. Basis of Estimate (enter code)	C. Type of Treatment/ Disposal (enter code)
6.1 Discharge to POTW		☐	☐	☐	N/A	6.1b ☐	
6.2 Other off-site location (Enter block number from Part II, Section 2.)	☐	☐	☐	☐	N/A	6.2b ☐	6.2c ☐☐☐
6.3 Other off-site location (Enter block number from Part II, Section 2.)	☐	☐	☐	☐	N/A	6.3b ☐	6.3c ☐☐☐
6.4 Other off-site location (Enter block number from Part II, Section 2.)	☐	☐	☐	☐	N/A	6.4b ☐	6.4c ☐☐☐

☐ (Check if additional information is provided on Part IV–Supplemental Information)

7. WASTE TREATMENT METHODS AND EFFICIENCY

A. General Wastestream (enter code)	B. Treatment Method (enter code)	C. Range of Influent Concentration (enter code)	D. Sequential Treatment? (check if applicable)	E. Treatment Efficiency Estimate	F. Based on Operating Data? Yes	No
7.1a W	7.1b 6 1 1	7.1c 4	7.1d ☐	7.1e 96 %	7.1f ☐	☑
7.2a ☐	7.2b N/A	7.2c ☐	7.2d ☐	7.2e %	7.2f ☐	☐
7.3a ☐	7.3b ☐☐☐	7.3c ☐	7.3d ☐	7.3e %	7.3f ☐	☐
7.4a ☐	7.4b ☐☐☐	7.4c ☐	7.4d ☐	7.4e %	7.4f ☐	☐
7.5a ☐	7.5b ☐☐☐	7.5c ☐	7.5d ☐	7.5e %	7.5f ☐	☐
7.6a ☐	7.6b ☐☐☐	7.6c ☐	7.6d ☐	7.6e %	7.6f ☐	☐
7.7a ☐	7.7b ☐☐☐	7.7c ☐	7.7d ☐	7.7e %	7.7f ☐	☐
7.8a ☐	7.8b ☐☐☐	7.8c ☐	7.8d ☐	7.8e %	7.8f ☐	☐
7.9a ☐	7.9b ☐☐☐	7.9c ☐	7.9d ☐	7.9e %	7.9f ☐	☐
7.10a ☐	7.10b ☐☐☐	7.10c ☐	7.10d ☐	7.10e %	7.10f ☐	☐
7.11a ☐	7.11b ☐☐☐	7.11c ☐	7.11d ☐	7.11e %	7.11f ☐	☐
7.12a ☐	7.12b ☐☐☐	7.12c ☐	7.12d ☐	7.12e %	7.12f ☐	☐
7.13a ☐	7.13b ☐☐☐	7.13c ☐	7.13d ☐	7.13e %	7.13f ☐	☐
7.14a ☐	7.14b ☐☐☐	7.14c ☐	7.14d ☐	7.14e %	7.14f ☐	☐

☐ (Check if additional information is provided on Part IV–Supplemental Information.)

8. OPTIONAL INFORMATION ON WASTE MINIMIZATION

(Indicate actions taken to reduce the amount of the chemical being released from the facility. See the instructions for coded items and an explanation of what information to include.)

A. Type of modification (enter code)	B. Quantity of the chemical in the wastestream prior to treatment/disposal Current reporting year (lbs/yr)	Prior year (lbs/yr)	Or percent change	C. Index	D. Reason for action (enter code)
☐☐			%	☐.☐	☐☐

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(Important: Type or print; read [illegible]uctions before completing form.)

Page 5 of 5

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EPA FORM R

PART IV. SUPPLEMENTAL INFORMATION

Use this section if you need additional space for answers to questions in Parts I and III.
Number or letter this information sequentially from prior sections (e.g., D.E. F, or 5.54, 5.55).

ADDITIONAL INFORMATION ON FACILITY IDENTIFICATION (Part I - Section 3)

3.5 SIC Code

3.7 Dun & Bradstreet Number(s)

3.8 EPA Identification Number(s) RCRA I.D. No.)

3.9 NPDES Permit Number(s)

3.10 Name of Receiving Stream(s) or Water Body(s)

ADDITIONAL INFORMATION ON RELEASES TO LAND (Part III - Section 5.5)

Releases to Land		A. Total Release (lbs/yr)				B. Basis of Estimate (enter code)
		A.1 Reporting Ranges			A.2 Enter Estimate	
		0	1–499	500–999		
5.5___ ☐☐☐ (enter code)	5.5___a					5.5___b ☐
5.5___ ☐☐☐ (enter code)	5.5___a					5.5___b ☐
5.5___ ☐☐☐ (enter code)	5.5___a					5.5___b ☐

ADDITIONAL INFORMATION ON OFF-SITE TRANSFER (Part III - Section 6)

		A. Total Transfers (lbs/yr)				B. Basis of Estimate (enter code)	C. Type of Treatment/ Disposal (enter code)
		A.1 Reporting Ranges			A.2 Enter Estimate		
		0	1–499	500–999			
6.___ Discharge to POTW	6.___a					6.___b ☐	
6.___ Other off-site location (Enter block number from Part II, Section 2.) ☐	6.___a					6.___b ☐	6.___c. ☐☐☐
6.___ Other off-site location (Enter block number from Part II, Section 2.) ☐	6.___a					6.___b ☐	6.___c. ☐☐☐

ADDITIONAL INFORMATION ON WASTE TREATMENT (Part III - Section 7)

A. General Wastestream (enter code)	B. Treatment Method (enter code)	C. Range of Influent Concentration (enter code)	D. Sequential Treatment? (check if applicable)	E. Treatment Efficiency Estimate	F. Based on Operating Data?	
					Yes	No
7.___a ☐	7.___b ☐☐☐	7.___c ☐	7.___d ☐	7.___e %	7.___f ☐	☐
7.___a ☐	7.___b ☐☐☐	7.___c ☐	7.___d ☐	7.___e %	7.___f ☐	☐
7.___a ☐	7.___b ☐☐☐	7.___c ☐	7.___d ☐	7.___e %	7.___f ☐	☐
7.___a ☐	7.___b ☐☐☐	7.___c ☐	7.___d ☐	7.___e %	7.___f ☐	☐
7.___a ☐	7.___b ☐☐☐	7.___c ☐	7.___d ☐	7.___e %	7.___f ☐	☐

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EPA Form 9350-1(1-88)

Form Approved OMB No.: 2070-0093
Approval Expires: 01/91
Page 1 of 5

(Important: Type or print; read instructions before completing form.)

U.S. Environmental Protection Agency

EPA FORM R

TOXIC CHEMICAL RELEASE INVENTORY REPORTING FORM

Section 313, Title III of The Superfund Amendments and Reauthorization Act of 1986

PART I. FACILITY IDENTIFICATION INFORMATION

13-87-01054588-3-VA

1.
1.1 Does this report contain trade secret information? ☐ Yes (Answer 1.2) ☑ No (Do not answer 1.2)
1.2 Is this a sanitized copy? ☐ Yes ☐ No
1.3 Reporting Year: 1987

2. CERTIFICATION (Read and sign after completing all sections.)

I hereby certify that I have reviewed the attached documents and that, to the best of my knowledge and belief, the submitted information is tru and complete and that the amounts and values in this report are accurate based on reasonable estimates using data available to the preparers of this report.

Name and official title of owner/operator or senior management official: James R. Batchelder Vice President & Manager, Technical & Environmental Ser. Tar & Woo

Signature: James R. Batchelder
Date signed: 6/30/88

3. FACILITY IDENTIFICATION

3.1 Facility or Establishment Name: Koppers Company, Inc.
Street Address: Rt 460
City: Salem
County: Roanoke
State: Virginia
Zip Code: 24153-

3.2 This report contains information for: (check one)
a. ☑ An entire covered facility.
b. ☐ Part of a covered facility.

3.3 Technical Contact: Robert Anderson
Telephone Number (include area code): (412) 227 - 2683

3.4 Public Contact: Mark A. Franck
Telephone Number (include area code): (703) 380 - 2061

3.5 a. SIC Code: 2491 b. N/A c. N/A

3.6 Latitude: Deg. 037 Min. 15 Sec. 00 Longitude: Deg. 080 Min. 07 Sec. 00

3.7 Dun & Bradstreet Number(s): a. 01-312-5770 b. N/A

3.8 EPA Identification Number (RCRA I.D. No.): a. VAD003125770 b. N/A

3.9 NPDES Permit Number(s): a. VA0001333 b. N/A

3.10 Name of Receiving Stream(s) or Water Body(s)
a. Roanoke River to Roanoke River Basin to Roanoke River Subbasin
b. N/A
c. N/A

3.11 Underground Injection Well Code (UIC) Identification No.: N/A

Where to send completed forms:

U.S. Environmental Protection Agency
P.O. Box 70266
Washington, DC 20024-0266
Attn: Toxic Chemical Release Inventory

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4. PARENT COMPANY INFORMATION

4.1 Name of Parent Company: N/A

4.2 Parent Company's Dun & Bradstreet No.: N/A

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(Important: Type or print; read instructions before completing form.)

Page 2 of 5

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EPA FORM R
PART II. OFF-SITE LOCATIONS TO WHICH TOXIC CHEMICALS ARE TRANSFERRED IN WASTES

1. PUBLICLY OWNED TREATMENT WORKS (POTW)

Facility Name N/A

Street Address

City

County

State

Zip -

2. OTHER OFF-SITE LOCATIONS – Number these locations sequentially on this and any additional page of this form you use.

☐ **Other off-site location** N/A

EPA Identification Number (RCRA ID. No.)

Facility Name

Street Address

City

County

State

Zip -

Is location under control of reporting facility or parent company? ☐ Yes ☐ No

☐ **Other off-site location**

EPA Identification Number (RCRA ID. No.)

Facility Name N/A

Street Address

City

County

State

Zip -

Is location under control of reporting facility or parent company? ☐ Yes ☐ No

☐ **Other off-site location**

EPA Identification Number (RCRA ID. No.)

Facility Name N/A

Street Address

City

County

State

Zip -

Is location under control of reporting facility or parent company? ☐ Yes ☐ No

☐ Check if additional pages of Part II are attached.

EPA Form 9350-1(1-88)

(Important: Type or print; read instructions before completing form.)

(This space for EPA use only.)

EPA FORM R

PART III. CHEMICAL SPECIFIC INFORMATION

1. CHEMICAL IDENTITY

1.1 ☐ Trade Secret (Provide a generic name in 1.4 below. Attach substantiation form to this submission.)

1.2 CAS # 132-64-9 (Use leading zeros if CAS number does not fill space provided.)

1.3 Chemical or Chemical Category Name: Dibenzofuran

1.4 Generic Chemical Name (Complete only if 1.1 is checked.)

2. MIXTURE COMPONENT IDENTITY (Do not complete this section if you have completed Section 1.)

Generic Chemical Name Provided by Supplier (Limit the name to a maximum of 70 characters (e.g., numbers, letters, spaces, punctuation)).

3. ACTIVITIES AND USES OF THE CHEMICAL AT THE FACILITY (Check all that apply.)

3.1	Manufacture:	a. ☐ Produce	b. ☐ Import	c. ☐ For on-site use/processing
		d. ☐ For sale/distribution	e. ☐ As a byproduct	f. ☐ As an impurity
3.2	Process:	a. ☐ As a reactant	b. ☐ As a formulation component	c. ☑ As an article component
		d. ☐ Repackaging only		
3.3	Otherwise Used:	a. ☐ As a chemical processing aid	b. ☐ As a manufacturing aid	c. ☐ Ancillary or other use

4. MAXIMUM AMOUNT OF THE CHEMICAL ON SITE AT ANY TIME DURING THE CALENDAR YEAR

04 (enter code)

5. RELEASES OF THE CHEMICAL TO THE ENVIRONMENT

You may report releases of less than 1,000 lbs. by checking ranges under A.1.		A. Total Release (lbs/yr) A.1 Reporting Ranges 0	1-499	500-999	A.2 Enter Estimate	B. Basis of Estimate (enter code)	C. % From Stormw
5.1 Fugitive or non-point air emissions	5.1a				640	5.1b E	
5.2 Stack or point air emissions	5.2a				10	5.2b E	
5.3 Discharges to water (Enter letter code from Part I Section 3.10 for streams(s).) 5.3.1 ☐	5.3.1a				0	5.3.1b ☐	5.3.1c N/D
5.3.2 ☐	5.3.2a				N/A	5.3.2b ☐	5.3.2c
5.3.3 ☐	5.3.3a				N/A	5.3.3b ☐	5.3.3c
5.4 Underground Injection	5.4a				N/A	5.4b ☐	
5.5 Releases to land 5.5.1 D99 (enter code)	5.5.1a			-	110	5.5.1b M	
5.5.2 D05 (enter code)	5.5.2a				290	5.5.2b O	
5.5.3 ☐☐☐ (enter code)	5.5.3a				N/A	5.5.3b ☐	

☐ (Check if additional information is provided on Part IV–Supplemental Information.)

EPA FORM R, Part III (Continued)

6. TRANSFERS OF THE CHEMICAL IN WASTE TO OFF-SITE LOCATIONS

You may report transfers of less than 1,000 lbs. by checking ranges under A.1.		A. Total Transfers (lbs/yr) A.1 Reporting Ranges 0	1–499	500–999	A.2 Enter Estimate	B. Basis of Estimate (enter code)	C. Type of Treatment/ Disposal (enter code)
6.1 Discharge to POTW					N/A	6.1b ☐	
6.2 Other off-site location (Enter block number from Part II, Section 2.)	☐				N/A	6.2b ☐	6.2c ☐☐☐
6.3 Other off-site location (Enter block number from Part II, Section 2.)	☐				N/A	6.3b ☐	6.3c ☐☐☐
6.4 Other off-site location (Enter block number from Part II, Section 2.)	☐				N/A	6.4b ☐	6.4c ☐☐☐

☐ (Check if additional information is provided on Part IV-Supplemental Information)

7. WASTE TREATMENT METHODS AND EFFICIENCY

A. General Wastestream (enter code)	B. Treatment Method (enter code)	C. Range of Influent Concentration (enter code)	D. Sequential Treatment? (check if applicable)	E. Treatment Efficiency Estimate	F. Based on Operating Data? Yes	No
7.1a W	7.1b A	7.1c 4	7.1d ☐	7.1e 96 %	7.1f ☐	☑
7.2a ☐	7.2b N/A	7.2c ☐	7.2d ☐	7.2e %	7.2f ☐	☐
7.3a ☐	7.3b ☐☐☐	7.3c ☐	7.3d ☐	7.3e %	7.3f ☐	☐
7.4a ☐	7.4b ☐☐☐	7.4c ☐	7.4d ☐	7.4e %	7.4f ☐	☐
7.5a ☐	7.5b ☐☐☐	7.5c ☐	7.5d ☐	7.5e %	7.5f ☐	☐
7.6a ☐	7.6b ☐☐☐	7.6c ☐	7.6d ☐	7.6e %	7.6f ☐	☐
7.7a ☐	7.7b ☐☐☐	7.7c ☐	7.7d ☐	7.7e %	7.7f ☐	☐
7.8a ☐	7.8b ☐☐☐	7.8c ☐	7.8d ☐	7.8e %	7.8f ☐	☐
7.9a ☐	7.9b ☐☐☐	7.9c ☐	7.9d ☐	7.9e %	7.9f ☐	☐
7.10a ☐	7.10b ☐☐☐	7.10c ☐	7.10d ☐	7.10e %	7.10f ☐	☐
7.11a ☐	7.11b ☐☐☐	7.11c ☐	7.11d ☐	7.11e %	7.11f ☐	☐
7.12a ☐	7.12b ☐☐☐	7.12c ☐	7.12d ☐	7.12e %	7.12f ☐	☐
7.13a ☐	7.13b ☐☐☐	7.13c ☐	7.13d ☐	7.13e %	7.13f ☐	☐
7.14a ☐	7.14b ☐☐☐	7.14c ☐	7.14d ☐	7.14e %	7.14f ☐	☐

☐ (Check if additional information is provided on Part IV-Supplemental Information.)

8. OPTIONAL INFORMATION ON WASTE MINIMIZATION

(Indicate actions taken to reduce the amount of the chemical being released from the facility. See the instructions for coded items and an explanation of what information to include.)

A. Type of modification (enter code)	B. Quantity of the chemical in the wastestream prior to treatment/disposal Current reporting year (lbs/yr)	Prior year (lbs/yr)	Or percent change	C. Index	D. Reason for action (enter code)
☐☐	______	______	______ %	☐ ☐	278386 ☐☐

Form Approved OMB No.: 2070-0093
Approval Expires: 01/91
Page 1 of 5

(Important: Type or print; read instructions before completing form.)

U.S. Environmental Protection Agency

EPA TOXIC CHEMICAL RELEASE INVENTORY REPORTING FORM

EPA FORM
R

Section 313, Title III of The Superfund Amendments and Reauthorization Act of 1986

PART I. FACILITY IDENTIFICATION INFORMATION

13-87-01054589-5-VA

1.	1.1 Does this report contain trade secret information? ☐ Yes (Answer 1.2) ☑ No (Do not answer 1.2)	1.2 Is this a sanitized copy? ☐ Yes ☐ No	1.3 Reporting Year 1987

2. CERTIFICATION (Read and sign after completing all sections.)

I hereby certify that I have reviewed the attached documents and that, to the best of my knowledge and belief, the submitted information is true and complete and that the amounts and values in this report are accurate based on reasonable estimates using data available to the preparers of this report.

Name and official title of owner/operator or senior management official
James R. Batchelder Vice President + Manager, Technical + Environmental Ser. Tar + Wo

Signature: James R Batchelder
Date signed: 6/30/88

3. FACILITY IDENTIFICATION

3.1 Facility or Establishment Name: Koppers Company, Inc.
Street Address: Rt. 460
City: Salem
County: Roanoke
State: Virginia
Zip Code: 24153

3.2 This report contains information for: (check one)
a. ☑ An entire covered facility.
b. ☐ Part of a covered facility.

3.3 Technical Contact: Robert Anderson
Telephone Number (include area code): (412) 227-2683

3.4 Public Contact: Mark A. Franck
Telephone Number (include area code): (703) 380-2061

3.5 a. SIC Code: 2491 b. N/A c. N/A

3.6

Latitude Deg.	Latitude Min.	Latitude Sec.	Longitude Deg.	Longitude Min.	Longitude Sec.
037	15	00	080	07	00

3.7 Dun & Bradstreet Number(s): a. 00-312-5770 b. N/A

3.8 EPA Identification Number (RCRA I.D. No.): a. VAD003125770 b. N/A

3.9 NPDES Permit Number(s): a. VA0001333 b. N/A

3.10 Name of Receiving Stream(s) or Water Body(s)
a. Roanoke River to Roanoke River Basin to Roanoke River Subbasin
b. N/A
c. N/A

3.11 Underground Injection Well Code (UIC) Identification No.: N/A

Where to send completed forms:

U.S. Environmental Protection Agency
P.O. Box 70266
Washington, DC 20024-0266
Attn: Toxic Chemical Release Inventory

JUL 13 1989

4. PARENT COMPANY INFORMATION

4.1 Name of Parent Company: N/A

4.2 Parent Company's Dun & Bradstreet No.

278388

JUL 12 1988

(Important: Type or print: read instructions before completing form.)

(This space for EPA use only.)

EPA FORM R
PART II. OFF-SITE LOCATIONS TO WHICH TOXIC CHEMICALS ARE TRANSFERRED IN WASTES

1. PUBLICLY OWNED TREATMENT WORKS (POTW)

Facility Name N/A

Street Address

City

County

State

Zip

2. OTHER OFF-SITE LOCATIONS – Number these locations sequentially on this and any additional page of this form you us

☐ Other off-site location N/A

EPA Identification Number (RCRA ID. No.)

Facility Name

Street Address

City

County

State

Zip

Is location under control of reporting facility or parent company? ☐ Yes ☐ No

☐ Other off-site location

EPA Identification Number (RCRA ID. No.)

Facility Name N/A

Street Address

City

County

State

Zip

Is location under control of reporting facility or parent company? ☐ Yes ☐ No

☐ Other off-site location

EPA Identification Number (RCRA ID. No.)

Facility Name N/A

Street Address

City

County

State

Zip

Is location under control of reporting facility or parent company? ☐ Yes ☐ No

☐ Check if additional pages of Part II are attached.

278389

(Important: Type or print; read instructions before completing form.)

(This space for EPA use only.)

EPA FORM R

PART III. CHEMICAL SPECIFIC INFORMATION

1. CHEMICAL IDENTITY

1.1 ☐ Trade Secret (Provide a generic name in 1.4 below. Attach substantiation form to this submission.)

1.2 CAS # 000092-52-4 (Use leading zeros if CAS number does not fill space provided.)

1.3 Chemical or Chemical Category Name: Biphenyl

1.4 Generic Chemical Name (Complete only if 1.1 is checked.)

2. MIXTURE COMPONENT IDENTITY (Do not complete this section if you have completed Section 1.)

Generic Chemical Name Provided by Supplier (Limit the name to a maximum of 70 characters (e.g., numbers, letters, spaces, punctuation)).

3. ACTIVITIES AND USES OF THE CHEMICAL AT THE FACILITY (Check all that apply.)

3.1 Manufacture:
- a. ☐ Produce
- b. ☐ Import
- c. ☐ For on-site use/processing
- d. ☐ For sale/distribution
- e. ☐ As a byproduct
- f. ☐ As an impurity

3.2 Process:
- a. ☐ As a reactant
- b. ☐ As a formulation component
- c. ☑ As an article component
- d. ☐ Repackaging only

3.3 Otherwise Used:
- a. ☐ As a chemical processing aid
- b. ☐ As a manufacturing aid
- c. ☐ Ancillary or other use

4. MAXIMUM AMOUNT OF THE CHEMICAL ON SITE AT ANY TIME DURING THE CALENDAR YEAR

04 (enter code)

5. RELEASES OF THE CHEMICAL TO THE ENVIRONMENT

You may report releases of less than 1,000 lbs. by checking ranges under A.1.

		A. Total Release (lbs/yr) A.1 Reporting Ranges 0	1-499	500-999	A.2 Enter Estimate	B. Basis of Estimate (enter code)	C. % From Stormwater
5.1 Fugitive or non-point air emissions	5.1a				280	5.1b E	
5.2 Stack or point air emissions	5.2a				10	5.2b E	
5.3 Discharges to water (Enter letter code from Part I Section 3.10 for stream(s).) 5.3.1 a	5.3.1a				0	5.3.1b ☐	5.3.1c N/D
5.3.2 ☐	5.3.2a				N/A	5.3.2b ☐	5.3.2c
5.3.3 ☐	5.3.3a				N/A	5.3.3b ☐	5.3.3c
5.4 Underground Injection	5.4a				N/A	5.4b ☐	
5.5 Releases to land 5.5.1 D99 (enter code)	5.5.1a				40	5.5.1b M	
5.5.2 D05 (enter code)	5.5.2a				130	5.5.2b O	
5.5.3 ☐☐☐ (enter code)	5.5.3a				N/A	5.5.3b ☐	

278390

☐ (Check if additional information is provided on Part IV-Supplemental Information.)

EPA FORM R, Part III (Continued)

6. TRANSFERS OF THE CHEMICAL IN WASTE TO OFF-SITE LOCATIONS

You may report transfers of less than 1,000 lbs. by checking ranges under A.1.	A. Total Transfers (lbs/yr) A.1 Reporting Ranges 0	1–499	500–999	A.2 Enter Estimate	B. Basis of Estimate (enter code)	C. Type of Treatment/ Disposal (enter code)
6.1 Discharge to POTW				N/A	6.1b ☐	
6.2 Other off-site location (Enter block number from Part II, Section 2.) ☐				N/A	6.2b ☐	6.2c ☐☐☐
6.3 Other off-site location (Enter block number from Part II, Section 2.) ☐				N/A	6.3b ☐	6.3c ☐☐☐
6.4 Other off-site location (Enter block number from Part II, Section 2.) ☐				N/A	6.4b ☐	6.4c ☐☐☐

☐ (Check if additional information is provided on Part IV–Supplemental Information)

7. WASTE TREATMENT METHODS AND EFFICIENCY

A. General Wastestream (enter code)	B. Treatment Method (enter code)	C. Range of Influent Concentration (enter code)	D. Sequential Treatment? (check if applicable)	E. Treatment Efficiency Estimate	F. Based on Operating Data? Yes	No
7.1a W	7.1b 5 1 1	7.1c 4	7.1d ☐	7.1e 96 %	7.1f ☐	☑
7.2a ☐	7.2b NA	7.2c ☐	7.2d ☐	7.2e %	7.2f ☐	☐
7.3a ☐	7.3b ☐☐☐	7.3c ☐	7.3d ☐	7.3e %	7.3f ☐	☐
7.4a ☐	7.4b ☐☐☐	7.4c ☐	7.4d ☐	7.4e %	7.4f ☐	☐
7.5a ☐	7.5b ☐☐☐	7.5c ☐	7.5d ☐	7.5e %	7.5f ☐	☐
7.6a ☐	7.6b ☐☐☐	7.6c ☐	7.6d ☐	7.6e %	7.6f ☐	☐
7.7a ☐	7.7b ☐☐☐	7.7c ☐	7.7d ☐	7.7e %	7.7f ☐	☐
7.8a ☐	7.8b ☐☐☐	7.8c ☐	7.8d ☐	7.8e %	7.8f ☐	☐
7.9a ☐	7.9b ☐☐☐	7.9c ☐	7.9d ☐	7.9e %	7.9f ☐	☐
7.10a ☐	7.10b ☐☐☐	7.10c ☐	7.10d ☐	7.10e %	7.10f ☐	☐
7.11a ☐	7.11b ☐☐☐	7.11c ☐	7.11d ☐	7.11e %	7.11f ☐	☐
7.12a ☐	7.12b ☐☐☐	7.12c ☐	7.12d ☐	7.12e %	7.12f ☐	☐
7.13a ☐	7.13b ☐☐☐	7.13c ☐	7.13d ☐	7.13e %	7.13f ☐	☐
7.14a ☐	7.14b ☐☐☐	7.14c ☐	7.14d ☐	7.14e %	7.14f ☐	☐

☐ (Check if additional information is provided on Part IV–Supplemental Information.)

8. OPTIONAL INFORMATION ON WASTE MINIMIZATION

(Indicate actions taken to reduce the amount of the chemical being released from the facility. See the instructions for coded items and an explanation of what information to include.)

A. Type of modification (enter code)	B. Quantity of the chemical in the wastestream prior to treatment/disposal Current reporting year (lbs/yr)	Prior year (lbs/yr)	Or percent change	C. Index	D. Reason for action (enter code)
☐☐			%	☐.☐	☐☐

(Important: Type or print; read instructions before completing form.)

(This space for EPA use only.)

EPA FORM R

PART IV. SUPPLEMENTAL INFORMATION

Use this section if you need additional space for answers to questions in Parts I and III. Number or letter this information sequentially from prior sections (e.g., D, E, F, or 5.54, 5.55).

ADDITIONAL INFORMATION ON FACILITY IDENTIFICATION (Part I - Section 3)

3.5	SIC Code		
3.7	Dun & Bradstreet Number(s)		
3.8	EPA Identification Number(s) RCRA I.D. No.)		
3.9	NPDES Permit Number(s)		
3.10	Name of Receiving Stream(s) or Water Body(s)		

ADDITIONAL INFORMATION ON RELEASES TO LAND (Part III - Section 5.5)

Releases to Land			A. Total Release (lbs/yr)				B. Basis of Estimate (enter code)	
			A.1 Reporting Ranges			A.2 Enter Estimate		
			0	1–499	500–999			
5.5___	☐☐☐ (enter code)	5.5___a					5.5___b	☐
5.5___	☐☐☐ (enter code)	5.5___a					5.5___b	☐
5.5___	☐☐☐ (enter code)	5.5___a					5.5___b	☐

ADDITIONAL INFORMATION ON OFF-SITE TRANSFER (Part III - Section 6)

			A. Total Transfers (lbs/yr)				B. Basis of Estimate (enter code)	C. Type of Treatment/ Disposal (enter code)
			A.1 Reporting Ranges			A.2 Enter Estimate		
			0	1–499	500–999			
6.___	Discharge to POTW	6.___a					6.___b ☐	
6.___	Other off-site location (Enter block number from Part II, Section 2.) ☐	6.___a					6.___b ☐	6.___c. ☐☐☐
6.___	Other off-site location (Enter block number from Part II, Section 2.) ☐	6.___a					6.___b ☐	6.___c. ☐☐☐

ADDITIONAL INFORMATION ON WASTE TREATMENT (Part III - Section 7)

A. General Wastestream (enter code)	B. Treatment Method (enter code)	C. Range of Influent Concentration (enter code)	D. Sequential Treatment? (check if applicable)	E. Treatment Efficiency Estimate	F. Based on Operating Data? Yes	No
7.___a ☐	7.___b ☐☐☐	7.___c ☐	7.___d ☐	7.___e %	7.___f ☐	☐
7.___a ☐	7.___b ☐☐☐	7.___c ☐	7.___d ☐	7.___e %	7.___f ☐	☐
7.___a ☐	7.___b ☐☐☐	7.___c ☐	7.___d ☐	7.___e %	7.___f ☐	☐
7.___a ☐	7.___b ☐☐☐	7.___c. ☐	7.___d ☐	7.___e %	7.___f ☐	☐
7.___a ☐	7.___b ☐☐☐	7.___c ☐	7.___d ☐	7.___e %	7.___f ☐	☐

(Important: Type or print; read instructions before completing form.)

EPA FORM R

PART IV. SUPPLEMENTAL INFORMATION

Use this section if you need additional space for answers to questions in Parts I and III. Number or letter this information sequentially from prior sections (e.g., D.E. F. or 5.54, 5.55).

(This space for EPA use only.)

ADDITIONAL INFORMATION ON FACILITY IDENTIFICATION (Part I – Section 3)

3.5	SIC Code		
3.7	Dun & Bradstreet Number(s)		
3.8	EPA Identification Number(s) RCRA I.D. No.)		
3.9	NPDES Permit Number(s)		
3.10	Name of Receiving Stream(s) or Water Body(s)		

ADDITIONAL INFORMATION ON RELEASES TO LAND (Part III – Section 5.5)

Releases to Land		A. Total Release (lbs/yr)				B. Basis of Estimate (enter code)
		A.1 Reporting Ranges			A.2 Enter Estimate	
		0	1–499	500–999		
5.5___ ☐☐☐ (enter code)	5.5___a					5.5___b ☐
5.5___ ☐☐☐ (enter code)	5.5___a					5.5___b ☐
5.5___ ☐☐☐ (enter code)	5.5___a					5.5___b ☐

ADDITIONAL INFORMATION ON OFF-SITE TRANSFER (Part III – Section 6)

		A. Total Transfers (lbs/yr)				B. Basis of Estimate (enter code)	C. Type of Treatment/ Disposal (enter code)
		A.1 Reporting Ranges			A.2 Enter Estimate		
		0	1–499	500–999			
6.___ Discharge to POTW	6.___a					6.___b ☐	
6.___ Other off-site location (Enter block number from Part II, Section 2.) ☐	6.___a					6.___b ☐	6.___c. ☐☐☐
6.___ Other off-site location (Enter block number from Part II, Section 2.) ☐	6.___a					6.___b ☐	6.___c. ☐☐☐

ADDITIONAL INFORMATION ON WASTE TREATMENT (Part III – Section 7)

A. General Wastestream (enter code)	B. Treatment Method (enter code)	C. Range of Influent Concentration (enter code)	D. Sequential Treatment? (check if applicable)	E. Treatment Efficiency Estimate	F. Based on Operating Data? Yes	No
7.___a ☐	7.___b ☐☐☐	7.___c ☐	7.___d ☐	7.___e %	7.___f ☐	☐
7.___a ☐	7.___b ☐☐☐	7.___c ☐	7.___d ☐	7.___e %	7.___f ☐	☐
7.___a ☐	7.___b ☐☐☐	7.___c ☐	7.___d ☐	7.___e %	7.___f ☐	☐
7.___a ☐	7.___b ☐☐☐	7.___c. ☐	7.___d ☐	7.___e %	7.___f ☐	☐
7.___a ☐	7.___b ☐☐☐	7.___c ☐	7.___d ☐	7.___e %	7.___f ☐	☐

APPENDIX B.

TRIP REPORTS

MRI

MIDWEST RESEARCH INSTITUT
Suite 3
401 Harrison Oaks Bouleva
Cary, North Carolina 275
Telephone (919) 467-52
Facsimile (919) 467-80

Date: September 22, 1988
(Revised May 10, 1989)

Subject: Site Visit--Koppers Company, Inc., Salem, Virginia
Wood Treatment Operations: Engineering Evaluation
EPA Contract 68-02-4379, Work Assignment No. 13 and 25
MRI Project 8950-13 and 8952-25

From: C. Vaught CV

To: Bruce Moore
Industrial Studies Branch
U. S. Environmental Protection Agency
Research Triangle Park, N.C. 27711

I. Purpose

To gain an understanding of the treatment process and practices employed by Koppers and identify potential sources of odor.

II. Place and Date

Koppers Company, Inc.
Post Office Box 908
Salem, Virginia 24153
(703) 380-2061

September 1, 1988

III. Attendees

Koppers Company (Koppers)

Mark Franck, Plant Manager

U. S. Environmental Protection Agency (EPA)

Bruce Moore

Midwest Research Institute (MRI)

Becky Nicholson
Chuck Vaught

IV. Process Description

The Koppers facility, located in Salem, Virginia, is a wood preserving plant that treats 20 to 25 percent seasoned and 75 to 80 percent unseasoned (green or undried) cross ties and switch ties for the Norfolk & Southern Railroad. The plant treats approximately 3,000 ties per day and operates 24 hours per day, 5 days per week. The plant has been in operation since 1955. A process flow diagram for the Koppers wood treatment process is presented in Figure 1 and photographs from the plant visit are attached.

A. Wood Treatment Process

The Koppers plant operates three steel treatment cylinders or retorts, each 8 feet in diameter and 140 feet long. The retrofits operate on a staggered schedule. Approximately 1,000 ties (approximately 3,200 ft^3 of wood) are treated per charge in each retort. The charge is rolled into the retorts on 16 small railcars each of which holds approximately 70 ties with small wood spacers between each tie. After the charge is loaded and the door is closed, the retort is filled with about 20,000 gallons of a 60/40 creosote/coal tar mixture (just enough to cover the ties) from one of four 50,000-gallon working tanks.

The creosote and coal tar are mixed offsite by the supplier. The plant is designed to use creosote solutions containing no more than 7 percent naphthalene. Excessive quantities of naphthalene in the preservative can precipitate and clog various transfer pipes. Koppers specifies to their preservative supplier that the creosote solution contain 7 percent naphthalene.

After the retort is filled and sealed, the contents are heated to between 190° and 200°F and 24 inches of mercury vacuum is pulled on the system for 16 to 18 hours (Boultonizing). This lowers the moisture content of the unseasoned wood by removing water from the sapwood and replacing it with the creosote oil. Water and vapors are carried out under induced vacuum to a condenser; the condensate is sent to an effluent treatment system. At the end of the Boultoning cycle, the creosote solution is pumped from the retort back to the work tanks. The vacuum is maintained in the retort for an additional one-half hour to reduce further the moisture content of the wood. By monitoring how much water has condensed in the condenser, the operator knows when the optimum moisture content has been reached. At that point, 50 psi pressure is applied for 30 minutes to an hour to force the residual creosote solution into the wood. Next, 30,000 gallons of the creosote solution from the working tanks is reintroduced into the retort, heated to between 190° and 200°F, and pressurized to between 160 and 170 psig for 2 to 4 hours depending on the species of wood (Rueping process). The creosote used in the Rueping process must contain less than 3 percent water in order for proper treatment to occur. The Boultonizing cycle dehydrates the creosote solution in addition to the charge that is being treated.

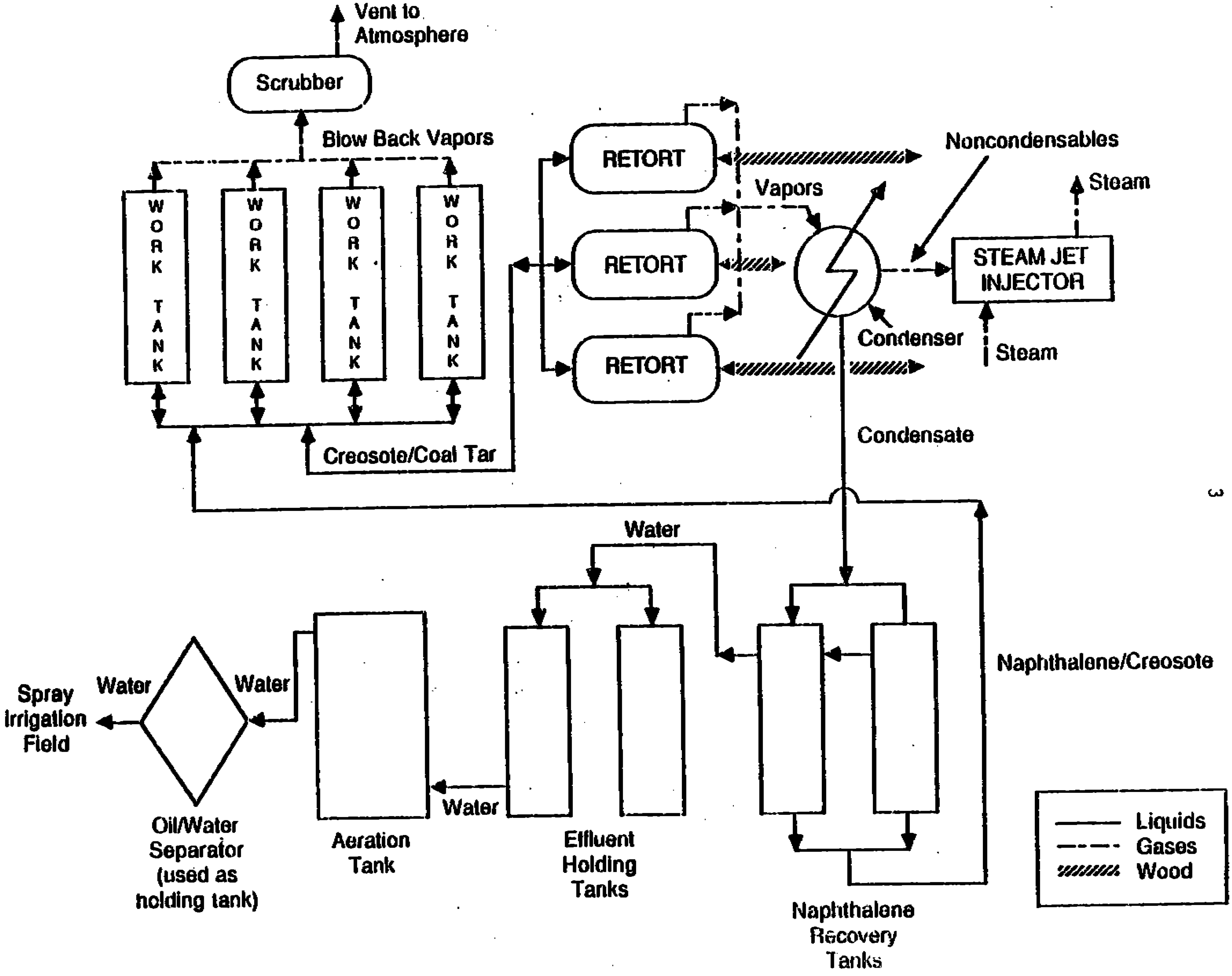


Figure 1. Process flow diagram of Koppers' Salem, Virginia wood treatment operation.

The Rueping process compresses the air in the interior wood cells and forces the preservative into the wood. The pressure is maintained until the target preservative retention level is reached. Koppers' target retention as specified by the Nolfcik & Southern Railroad is 7 to 8 pounds of preservative per cubic foot of wood with 65 percent of the annual rings in the tie being treated for red oak. When this is accomplished, the pressure is relieved and the retort is emptied of preservative. The expanding air in the interior wood cells expels the preservative leaving an empty, treated cell (i.e., the creosote adheres to the cell walls). The vacuum (22 to 24 inches of mercury) is then reapplied for about 1 hour to extract residual creosote that tends to drip upon removal of the charge, thus producing a cleaner product and allowing recovery and recycle of excess preservative (which currently costs $0.80 to $1.40 per gallon). A diagram depicting the pressure fluctuations during a treatment cycle is shown in Figure 2.

Following the final vacuum, the retort door is opened, the rail bridge is lowered, and the charge is pulled from the retort by a small locomotive. During the site visit, a small amount (approximately 5 gallons) of creosote spilled from the retort into the sump below when the retort door was opened.

B. Effluent Treatment System

Koppers is in the process of closing its wastewater treatment lagoons and is installing an aboveground effluent treatment system. The effluent treatment system will handle condensate exiting the condenser and the scrubber water used to treat the working tank vapors. These effluents are initially fed into one of two 28,000-gallon naphthalene recovery tanks, which are kept at about 100°F. The naphthalene (mp = 176°F) contained in the effluent crystallizes and falls to the bottom of the tanks where it is heated to melting and drained off the tank bottom. The recovered naphthalene is returned to the working tanks for reuse. The aqueous fraction of the effluent from the naphthalene recovery system is sent to one of two 150,000-gallon effluent holding tanks. The effluent is then sent to an activated sludge tank for biological removal of other dissolved organics. From there it is pumped to an oil/water separator that currently serves as a holding basin. After testing for phenol and other organic compounds, the effluent is sent to a 7 acre spray irrigation field. A soon-to-be-constructed city sewer line will be the ultimate disposal route for the effluent in the holding basin.

V. Odor Sources

The three predominant sources of odor (and potential air toxics) identified at the Koppers facility are:

1. Treated wood exiting the retorts;
2. Steam jet injectors; and
3. Blow-back vapors from work tanks.

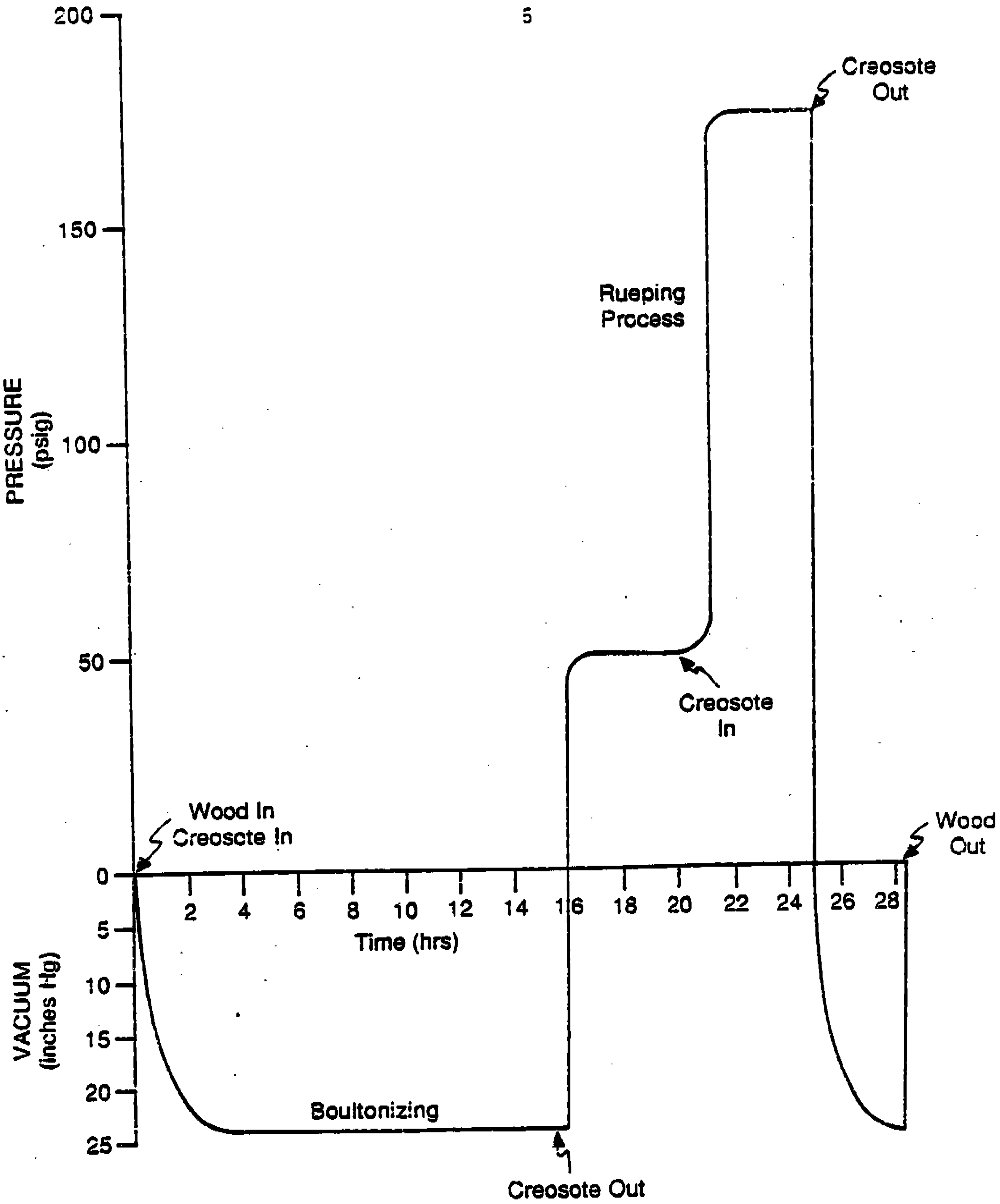


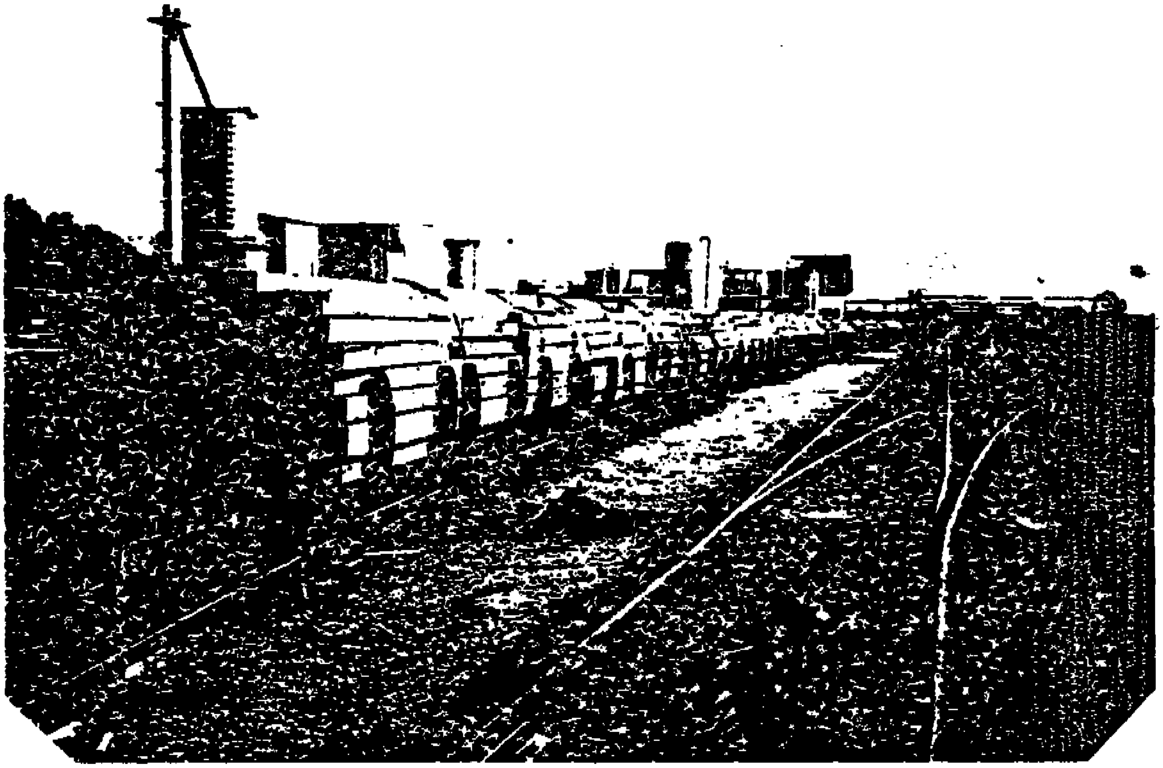
Figure 2. Pressure fluctuations in the retort during the treatment cycle at Koppers' Salem, Virginia wood treatment plant.

Visible emissions were observed from a charge that had been pulled out 14 hours prior to our visit and was being unloaded into another railcar. During the visit, a freshly treated charge was pulled from the center retort. As the retort door opened, a dense, white plume of gas exited the treatment chamber and continued to be emitted as the charge was being pulled from the retort. The charge, approximately 130 feet long, fumed and emitted a white vapor cloud and a strong creosote odor. There was a noticeable odor of creosote coming from the stock yard where the treated ties are stored.

The steam jet injectors used to produce the vacuum in the retorts are also a source of odors. To induce the vaccum on the retorts Koppers uses two stream jet injectors. A 4-inch steam jet is used to draw the system pressure down to between 22 and 24 inches of mercury. This usually takes between 1 and 2 hours. Ideally, once the vacuum has been obtained, the operator will switch over to a 2-inch steam jet to maintain the vacuum for the remainder of the cycle to save energy. However, during periods of high steam demand there may not be enough steam available from the power plant's boiler to maintain a 24 inch of mercury vacuum using the 2-inch steam jet. Therefore, the 4-inch steam jet may remain on the entire vacuum cycle if the steam demand for the rest of the plant is high (i.e., heat for retorts, working tanks, buildings, etc.). The single pass water cooled condenser, operating between the retort and the steam jet, may not be capable of removing all of the organics, which become entrained in the steam jet. A large, dense steam plume was emitted from the 4-inch injector, and a strong creosote odor was noted when the wind shifted. The 2-inch injector emitted significantly less visible emissions than did the 4-inch injector.

Working losses from the four creosote working tanks could be a significant contributor to the odor problem. A working tank blow back event occurs when the creosote is sent back to the work tanks. The air displaced by the filling of the work tanks is at equilibrium with the preservative in the tanks. The 30,000 gallons of preservative used to fill a retort will displace approximately 4,000 cubic feet of air when the solution is sent back to the work tanks. This event will occur twice during the Koppers treatment cycle. It takes approximately 15 minutes to empty the retort of preservative. The work tanks are equipped with a common scrubber consisting of a horizontally mounted 20,000-gallon tank half full of water with a spray system inside. When a blow back occurs the displaced vapors from the work tanks enter the top of the scrubber and contact the spray. The exhaust gas is then vented to the atmosphere. Its effectiveness as a scrubber would be expected to approach zero if the water is not changed periodically and allowed to reach saturation. At that point it could only serve as a condenser. We did not witness a blow back event during our visit. Currently the plant has no formal procedures in place for periodically changing or regenerating the scrubber water. The plant manager stated that no procedures are in place because the scrubber has been very effective at controlling blowback odors. He states that monitoring the water level alone has maintained the effectiveness of the scrubber. If it becomes necessary to change the water or empty the scrubber, the water will be sent to the effluent treatment system.

Attachment

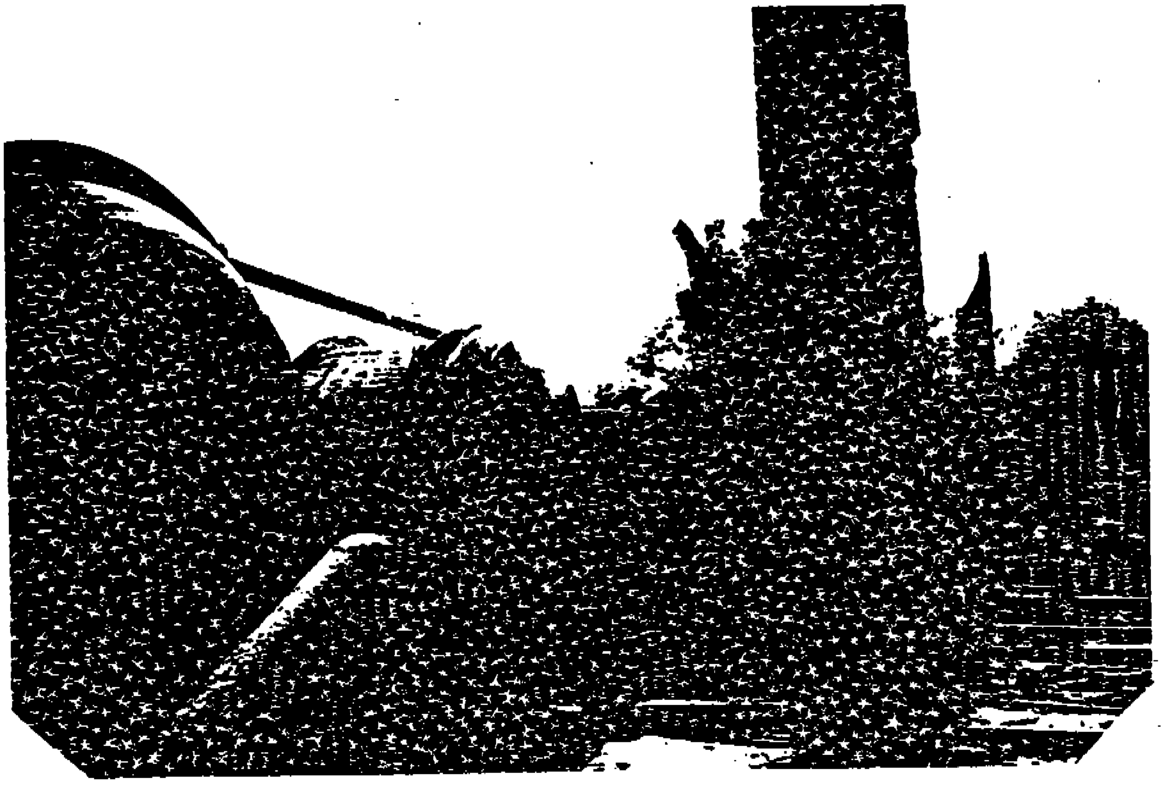


Cross ties loaded on railcars and awaiting treatment.

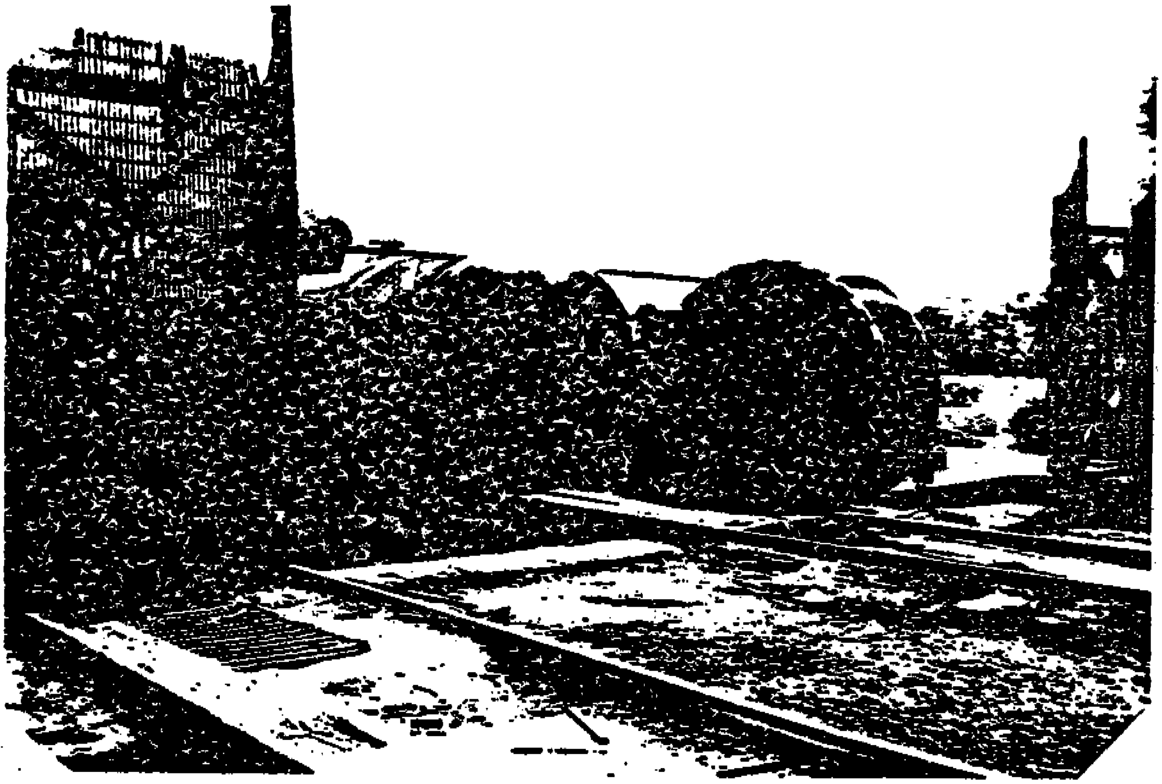
Unloading of a treated charge.

Attachment

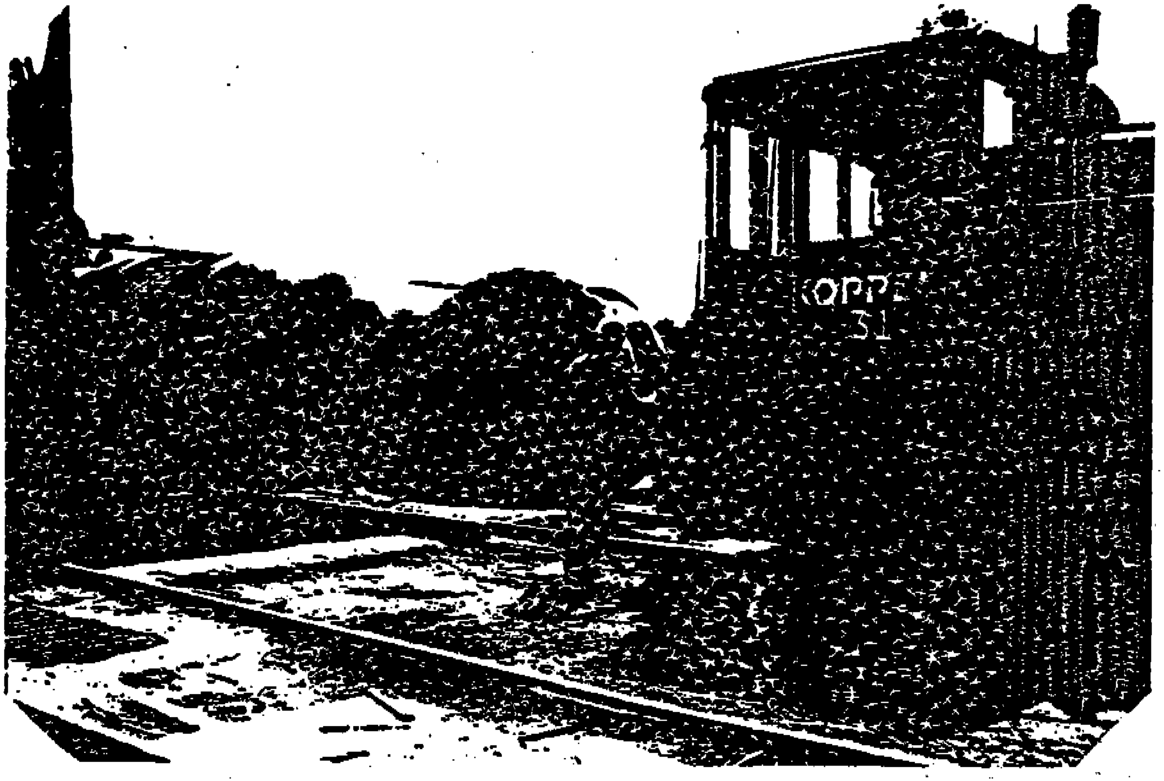
Initial opening of the retort door.



Lowering of the rail bridge.



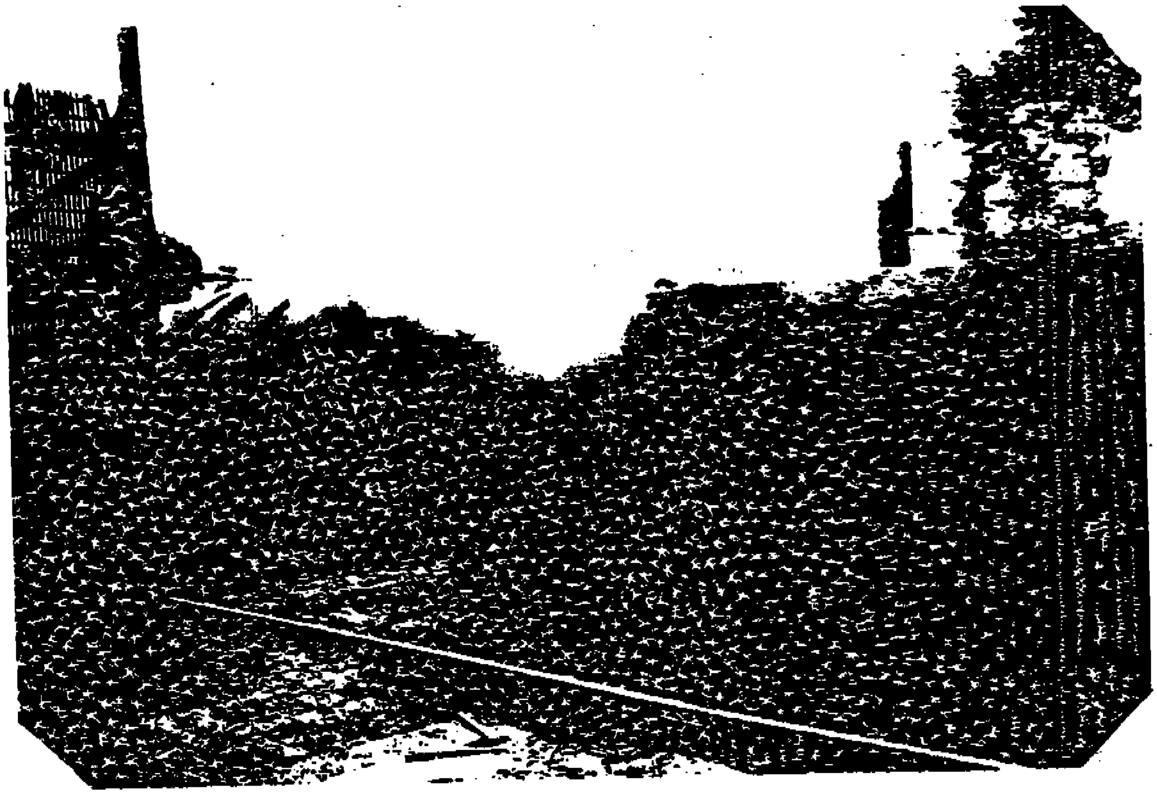
Vapors escaping from opened retort.



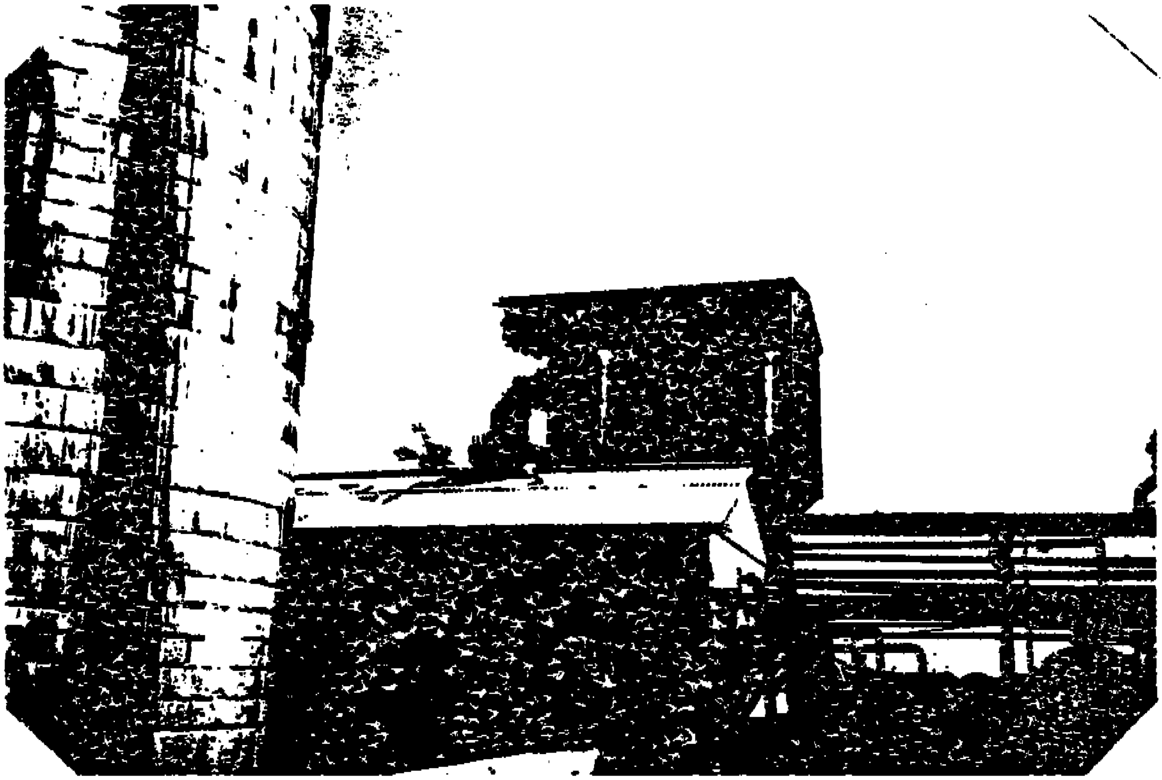
Preparing to pull the charge.

Attachment

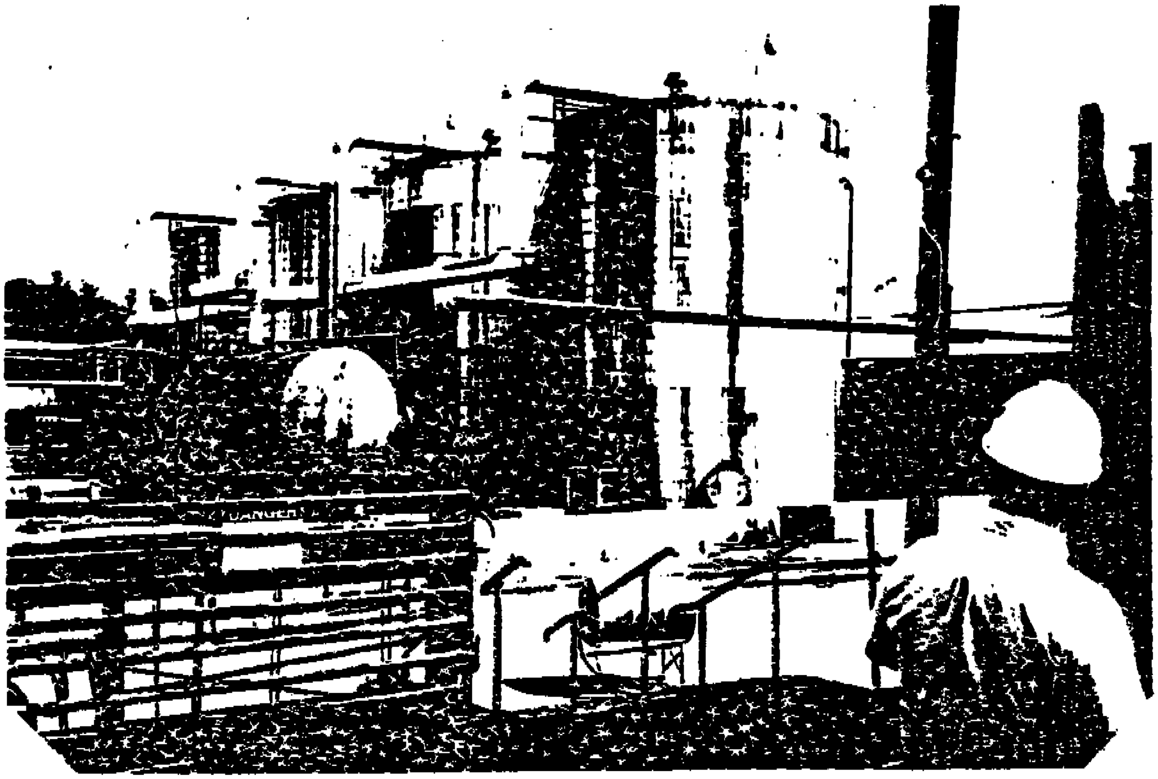
Charge being pulled from retort.



Charge being pulled from retort.



View of 4-inch steam injector plume.



View of four creosote working tanks and scrubber
used to control blow back vapors.

MRI

MIDWEST RESEARCH INSTITU
Suite 3
401 Harrison Oaks Bouleva
Cary, North Carolina 275
Telephone (919) 467-52
Facsimile (919) 467-80

Date: September 22, 1988

Subject: Site Visit--Jennison-Wright Corp., Toledo, Ohio
Wood Treatment Operations: Engineering Evaluation
EPA Contract 68-02-4379. Work Assignment Nos. 13 and 25
MRI Project 8950-13 and 8952-25

From: C. Vaught CV

To: Bruce Moore
Industrial Studies Branch
U. S. Environmental Protection Agency
Research Triangle Park, N.C. 27711

I. Purpose

To gain an understanding of the treatment process and practices employed by Jennison-Wright and identify potential sources of odor.

II. Place and Date

Jennison-Wright Corp.
2332 Broadway
Toledo, Oho 43609
(419) 382-3411

September 7, 1988

III. Attendees

Jennison-Wright

Don Wynn, Plant Manager
David Zook, Assistant Plant Manager

U. S. Environmental Protection Agency (EPA)

Bruce Moore

Midwest Research Institute (MRI)

Chuck Vaught

Department of Public Utilities, Environmental Services

Jeff Twaddle

IV. Process Description

The Jennison-Wright facility, located in Toledo, Ohio, is a wood preserving plant that treats air dried cross ties and floor block material. In the tie treating operation, approximately 430 ties are treated per charge with between two and three charges treated per day. The plant has been in operation since 1905 and operates 20 hours per day, 5 days per week. A process flow diagram for the Jennison-Wright wood treatment process is presented in Figure 1.

A. Wood Treatment Process

The Jennison-Wright plant operates three treatment cylinders or retorts, each 6 feet in diameter. Cylinders 1 and 2 (see Figure 1) are about 80 years old and are used to treat floor blocks. Each are a 100 feet long. The floor blocks are loaded into cages and rolled into the cylinders on railcars. The creosote solution is introduced into the cylinders from a dedicated working tank. The treatment cycle is short (about 2 hours) and is designed only to coat the outside of the blocks with preservative.

The focus on our visit was to characterize the treatment process and odor control techniques associated with cylinder 3, a new, 120-foot-long cylinder installed in 1987 to treat railroad ties. The new cylinder was installed to replace an old, worn out cylinder. The purpose of the installation was to improve production schedules and quality so the facility can function in a more cost-effective, environmentally acceptable manner and, thus, enhance the company's competitive position. Because cylinder 3 is a new source, the State of Ohio Environmental Protection Agency required Jennison-Wright to file a permit to assure compliance with current State air quality requirements (permit attached). The permit specifies that all new sources must employ best available technology (BAT) for control of air emissions.

Jennison-Wright treats railroad ties to varying preservative retention specifications. Ties treated for Jennison-Wright stock are treated to a retention level between 4 and 5 pounds of preservative per cubic foot. The Grand Truck railroad specifies product retention of 7 pounds per cubic foot, and the Norfolk and Southern railroad requires retention of 8 pounds per cubic foot and sterilization of the ties in the treatment cycle. The process used to treat ties for the Norfolk and Southern railroad was observed during our visit. Jennison-Wright considers annual production information to be confidential.

Approximately 430 ties (1,148 ^{3} of wood) are treated per charge in cylinder 3 using the Reuping process, which compresses the air in interior wood cells and forces preservative into the wood. The charge is rolled into the retorts on 14 small railcars each of which holds approximately 30 ties. After the charge is loaded and the door is closed, the retort is filled with about 17,000 gallons of a 60/40 creosote/coal tar mixture from one of three, 50,000-gallon working tanks.

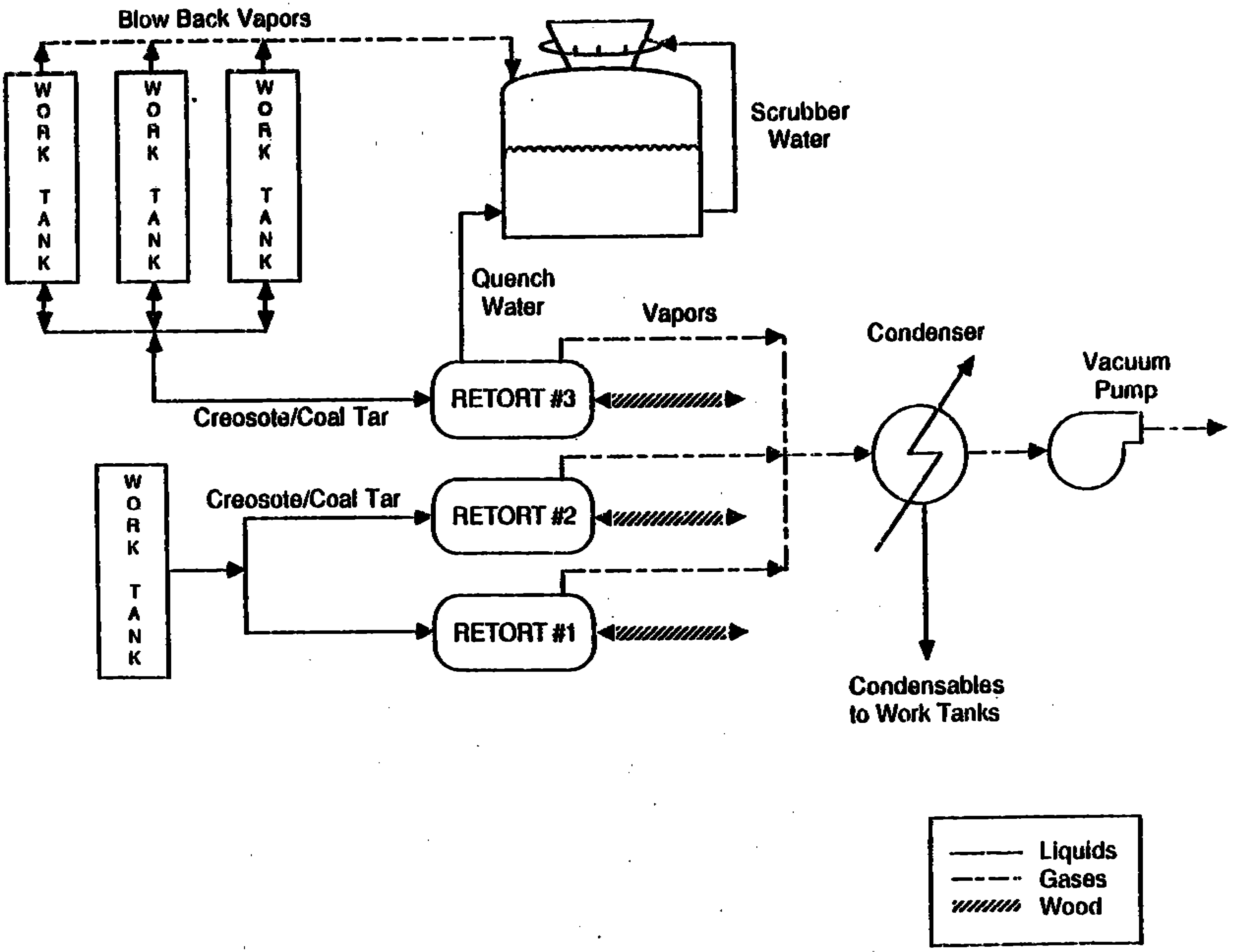


Figure 1. Process flow diagram of Jennison-Wright's Toledo, Ohio wood treatment operation.

After the retort is filled, the contents are heated to 205°F and the pressure in the retort is raised to about 30 psig for approximately 4 hours. The initial pressure requirement is a function of how readily the charge accepts the creosote and obtains its target retention of 7 to 8 pounds of preservative per cubic foot of wood. By holding the temperture of the ties at 205°F for 4 hours, the ties are sterilized to prevent decay that destroys the wood from within. Following the sterilization cycle, the pressure is stepped up approximately 10 psig every 15 minutes until the pressure in the retort reaches 200 psig. The pressure (200 psig) is maintained until the target preservative retention level is reached. Again, the rate of increase in system pressure is dependent on the type of wood being treated and how readily the wood cells accept the creosote.

When the target retention level is reached, the pressure is relieved, and the retort is emptied of preservative. A moderate pressure of about 10 psig is maintained in the retort to aid the pump in transferring the creosote back to the work tanks. The expanding air in the interior wood cells expels the preservative leaving an empty, treated cell. A vacuum (25 inches of mercury) is then applied for 1 hour to extract residual creosote that tends to drip from the charge, thus producing a cleaner product and allowing the recovery and recycle of excess preservative. A diagram depicting the pressure fluctuations during a treatment cycle is shown in Figure 2.

Following the vacuum cycle, 17,000 gallons of water are pumped into the retort to quench the treated ties, lower their temperature, and reduce fugitive emissions of lower boiling point organics typically associated with odor. The quench water is recirculated in a closed loop system through a 500,000-gallon fixed-roof tank that is half full of water. Blow back vapors generated from the displacement of air in the work tanks are introduced into the vapor space in the tank.

A cone-shaped water scrubber is mounted on top of the tank. The diameters of the scrubber at the top and bottom are approximately 5 feet and 15 inches, respectively, and it is approximately 6 feet in height. A manifold encircles the scrubber midway up the cone and supplies eight spray nozzles inside the scrubber with water (24 gallons per minute) taken from inside the tank. The spray scrubs and condenses vapors and carries the condensate back down into the tank. We observed the scrubber system in operation during a blow back of creosote to the work tanks. No visible emissions were observed from the scrubber during the blow back. We were not in a position to detect whether there were odors coming from the scrubber.

For the purposes of our visit and to illustrate the effectiveness of the water quench system, Jennison-Wright personnel opened the retort door and allowed us to view the charge in the retort after the pressure cycle (before the vacuum was applied) and after the vacuum cycle (before the water quench cycle). Following the pressure cycle, a white vapor cloud exited the retort as the door was opened. Along the end of the charge, excess preservative and expanding air could be seen exiting the hot ties.

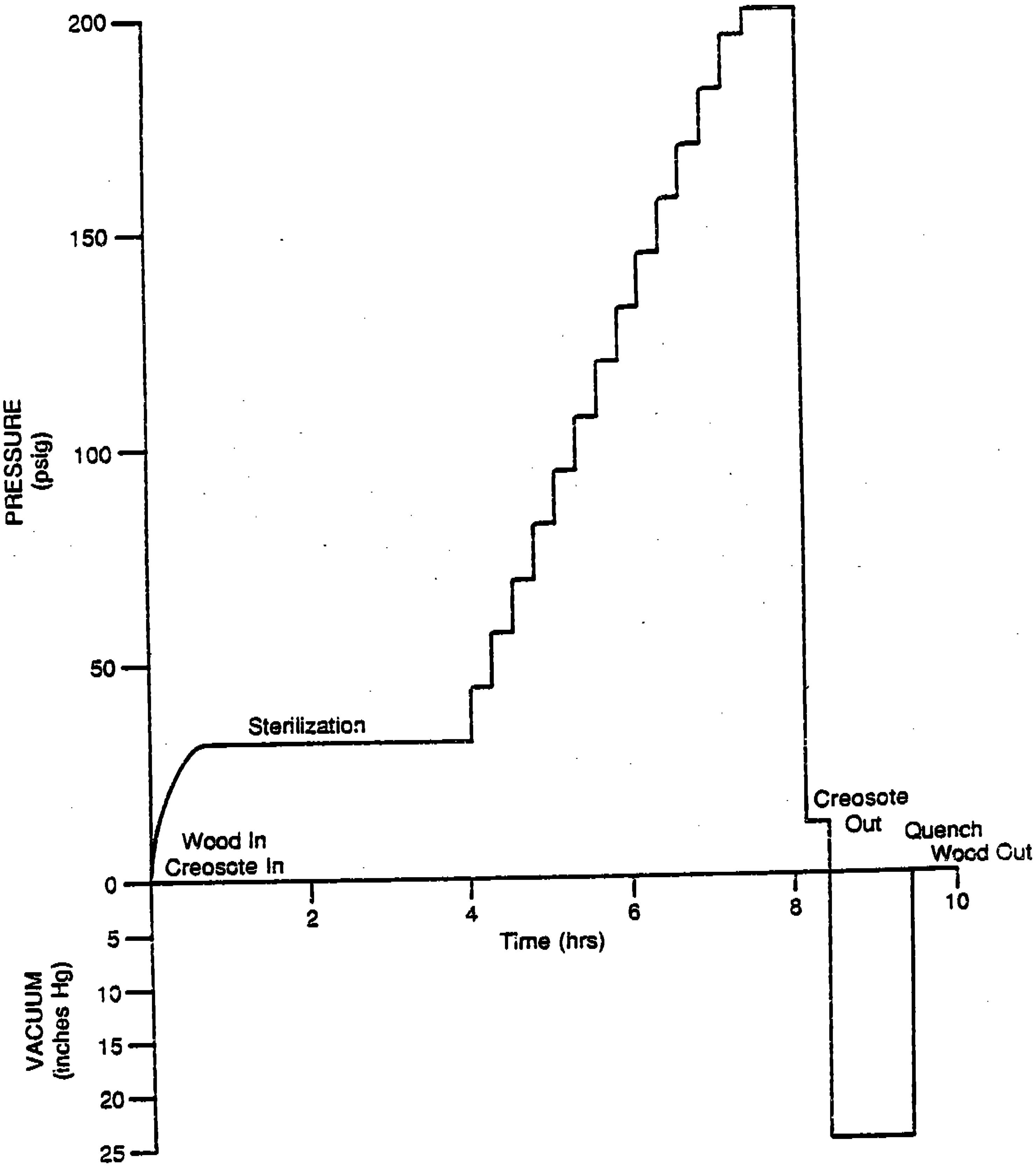


Figure 2. Pressure fluctuations in the retort during the treatment cycle at Jennison-Wright's Toledo, Ohio wood treatment plant.

The ties appeared wet with preservative as excess preservative dripped and fumed from the charge. After the vacuum cycle was completed, the door was once again opened. The charge still appeared hot, and a white plume of vapor exited the retort although not as profusely as was observed before the vacuum cycle. The charge appeared dry with little or no excess preservative dripping from the charge. After the water quench cycle the treated charge was removed. The ties appeared to be substantially cooler, and almost no visible emissions were observed. We did not detect a strong odor of creosote from the freshly treated charge.

Attachment

Attachment

OhioEPA
State of Ohio Environmental Protection Agency
P.O. Box 1049, 1800 WaterMark Dr.
Columbus, Ohio 43266-0149

Toward A Cleaner Environment

Richard F. Celeste
Governor

June 22, 1988

Re: Modification to Permit to
Install No. 04-394

Lucas County

Jennison-Wright Corp.
Thomas Kmiec, P.E.
30195 Chagrin Blvd., 220E
Pepper Pike, Ohio 44124

CERTIFIED MAIL

Dear Sir:

Enclosed please find a modification to the Ohio EPA Permit to Install referenced above which will modify the terms and conditions.

You are hereby notified that this action of the Director is final and may be appealed to the Environmental Board of Review pursuant to Section 3745.04 of the Ohio Revised Code. The appeal must be in writing and set forth the action complained of and the grounds upon which the appeal is based. It must be filed with the Environmental Board of Review within thirty (30) days after notice of the Director's action. A copy of the appeal must be served on the Director of the Ohio Environmental Protection Agency and the Environmental Law Division of the Office of the Attorney General within three (3) days of filing with the Board. An appeal may be filed with the Environmental Board of Review at the following address: Environmental Board of Review, 236 East Town Street, Room 300, Columbus, Ohio 43215.

Very truly yours,

Thomas G. Rigo

Thomas G. Rigo, Manager
Field Operations Section
Division of Air Pollution Control

Enclosure

cc: US EPA
Toledo Environmental Services Division
Kathleen Shannon

Issuance Date: June 22, 1988

Effective Date: June 22, 1988

OHIO ENVIRONMENTAL PROTECTION AGENCY

MODIFICATION TO PERMIT TO INSTALL NO. 04-394

Name of Applicant: Jennison-Wright Corp.
Address: 30195 Chagrin Blvd., 220E
City: Pepper Pike, Ohio 44124
Telephone: (216) 464-6740

The Ohio EPA has issued a modification for the Ohio EPA Permit to Install referenced above.

The Permit to Install issued to Jennison-Wright Corp. (PTI No. 04-394) is hereby modified in the following manner: Special terms and conditions.

The reason for this modification is: NSPS was not included in the initial PTI.

The above named entity is hereby granted a modification to the permit to install described above pursuant to Chapter 3745-31 of the Ohio Administrative Code. Issuance of this modification does not constitute expressed or implied approval or agreement that, if constructed or modified in accordance with the plans included in the application, in compliance with applicable State and Federal laws and regulations, and does not constitute expressed or implied assurance that if constructed or modified in accordance with those plans included in the application, the above described source(s) of pollutants will be granted the necessary operating permits.

Ohio Environmental Protection Agency

Richard L Shank

Director

Substantial construction for installation must take place within eighteen months of the effective date of this permit. This deadline may be extended by up to twelve months, if application is made to the Director within a reasonable time before the termination date and the party shows good cause for any such extension.

The Director of the Ohio Environmental Protection Agency, or his authorized representatives, may enter upon the premises of the above-named applicant during construction and operation at any reasonable time for the purpose of making inspections, conducting tests, examining records or reports pertaining to the construction, modification or installation of the above described source of environmental pollutants.

As specified in OAC Rule 3745-31-05, all new sources must employ Best Available Technology (BAT). Compliance with the terms and conditions of this permit will fulfill this requirement.

The specified permit fee must be remitted within 15 days of the effective date of this permit to install.

The proposed source shall be constructed in strict accordance with the plans and application submitted for this permit to the Director of the Ohio Environmental Protection Agency. There may be no deviation from the approved plans without the express, written approval of the Agency. Any deviations from the approved plans or the above conditions may lead to such sanctions and penalties as provided under Ohio law. Approval of these plans does not constitute an assurance that the proposed facilities will operate in compliance with all Ohio laws and regulations. Additional facilities shall be installed upon orders of the Ohio Environmental Protection Agency if the proposed sources are inadequate or cannot meet applicable standards.

EMISSION SUMMARY

The air contaminant sources listed below comprise the Permit to Install for Jennison-Wright Corp. located in Lucas County. The sources listed below shall not exceed the emission limits/control requirements contained in the following table:

Ohio EPA Source No.	Source Identification	BAT Determination	Applicable Ohio EPA rule	Allowable Emissi (lb/hr, lb/MMBTU or/DSCF,etc.)
T008	Work tank #1	BAT for this source is being vented thru storage tank A (T010) & not to exceed 210°F	3745-31-05 NSPS Subpart Kb	No V.E.

Ohio EPA Source No.	Source Identification	BAT Determination	Applicable Ohio EPA rule	Allowable Emissio (lb/hr, lb/MMBTU, or/DSCF, etc.)
T009	Work tank #2	Same as T008	Same as T008	Same as T008
T010	Storage tank A	BAT for this source is a vapor recovery system which reduces emission such that there are no visible emissions other than water vapor & all gauging is gas tight	Same as T008	Same as T008 exce water vapor

SUMMARY
TOTAL NEW SOURCE EMISSIONS

Pollutant	Tons/Year
Creosote/Particulate	1.70

This condition in no way limits the applicability of any other state or federal regulation.

APPLICABILITY

This Permit to Install is applicable only to the air contaminant sources listed and does not include the installation or modification of wastewater disposal systems or solid waste disposal facilities. Separate application must be made to the Director for the installation or modification of any such wastewater disposal systems or solid waste disposal facilities.

NSPS REQUIREMENTS

The following sources are subject to the applicable provisions of the New Source Performance Standards (NSPS) as promulgated by the United States Environmental Protection Agency, 40 CFR Part 60.

Source No.	Source Description	NSPS Regulation (Subpart)
T008	Work Tank #1	Subpart Kb
T009	Work Tank #2	Subpart Kb
T010	Storage Tank A	Subpart Kb

The application and enforcement of these standards are delegated to the Ohio EPA. The requirements of 40 CFR Part 60 are also federally enforceable.

Pursuant to the NSPS, the source owner/operator is hereby advised of the requirement to report the following at the appropriate times:

1. Construction date (no later than 30 days after such date);
2. Anticipated start-up date (not more than 60 days or less than 30 prior to such date);
3. Actual start-up date (within 15 days after such date); and
4. Date of performance testing (at least 30 days prior to testing).

Reports are to be sent to:

Ohio Environmental Protection Agency
Authorization and Compliance Unit
P.O. Box 1049
Columbus, Ohio 43266-0149

and Toledo Environmental Services Division
26 Main Street
Toledo, Ohio 43605

WASTE DISPOSAL

The owner/operator shall comply with any applicable state and federal requirements governing the storage, treatment, transport, and disposal of any waste material generated by the operation of the sources.

REPORTING

Any reports required by the Permit to Install shall be submitted to Toledo Environmental Services Division.

PERMIT TO OPERATE APPLICATION

A Permit to Operate Application and a $15 application fee must be submitted to the appropriate field office for each source in this Permit to Install. In accordance with OAC rule 3745-35-02, the application shall be made at least ninety days prior to start-up of the source.

PUBLIC DISCLOSURE

The facility is hereby notified that this permit, and all agency records concerning the operation of this permitted source are subject to public disclosure in accordance with OAC Rule 3745-49-03.

MALFUNCTION/ABATEMENT

This source and its associated air pollution control system(s) shall be maintained regularly in accordance with good engineering practices and the recommendations of the respective manufacturers in order to minimize air contaminant emissions.

In accordance with OAC Rule 3745-15-06, any malfunction of the source(s) or associated air pollution control system(s) shall be reported immediately to the Toledo Environmental Services Division. Except as provided by OAC Rule 3745-15-06(A)(3), scheduled maintenance of air pollution control equipment, that requires the shutdown or bypassing of said equipment, must be accompanied by the shutdown of the associated air pollution sources.

ADDITIONAL SPECIAL TERMS AND CONDITIONS

1. The Permittee shall conduct performance tests to demonstrate that the air contaminant source operates or within 90 days of start-up of operation will operate in compliance with the requirements of this Permit to Install and with applicable Ohio Environmental Protection Agency laws and rules. The first such test shall be conducted within 15 days of start-up of operation. A minimum of 48 hours written notice of each test shall be given to the Toledo Environmental Services Division.

2. Tank T008, T009, and T010 shall be equipped with a device to determine the temperature of the stored creosote.

3. The Permittee shall remove from service two of the present work tanks within 90 days after T008 and T009 are operational.

4. The owner/operator shall keep readily accessible records showing the dimension of the storage vessels (T008, T009 and T010) and an analysis showing the capacity of each vessel.

TECHNICAL REPORT DATA

Please read instructions on the reverse before completing

1. REPORT NO.
EPA 450/3-89-028

2.

3. RECIPIENT'S ACCESSION NO.

4. TITLE AND SUBTITLE
Evaluation of Emission Sources From Creosote Wood Treatment Operations

5. REPORT DATE
June 1989

6. PERFORMING ORGANIZATION CODE

7. AUTHOR(S)
Vaught, C. C., Nicholson, R. L.

8. PERFORMING ORGANIZATION REPORT NO.

9. PERFORMING ORGANIZATION NAME AND ADDRESS
Midwest Research Institute
401 Harrison Oaks Boulevard, Suite 350
Cary, North Carolina 27513

10. PROGRAM ELEMENT NO.

11. CONTRACT/GRANT NO.
68-02-4379

12. SPONSORING AGENCY NAME AND ADDRESS
U. S. Environmental Protection Agency
Control Technology Center
Research Triangle Park, N.C. 27711

13. TYPE OF REPORT AND PERIOD COVERED
Final

14. SPONSORING AGENCY CODE
EPA 200/04

15. SUPPLEMENTARY NOTES

16. ABSTRACT

This document discusses each of the preservatives and the processes used to treat a variety of wood products concentrating on the use of creosote for the treatment of crossties. Of particular concern are the emission sources associated with the release of odor and air toxics and the technologies currently in use to control them.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Wood treatment Wood preserving Creosote Pentachlorophenol	Air pollution control	

18. DISTRIBUTION STATEMENT
Release unlimited

19. SECURITY CLASS (This Report)
Unclassified

20. SECURITY CLASS (This page)
Unclassified

21. NO. OF PAGES
37

22. PRICE