EPA-453/R-96-012

Technical Support Document:

CHEMICAL RECOVERY COMBUSTION SOURCES AT KRAFT AND SODA PULP MILLS

Emission Standards Division

U. S. ENVIRONMENTAL PROTECTION AGENCY
Office of Air and Radiation
Office of Air Quality Planning and Standards
Research Triangle Park, NC 27711

October 1996

This report has been reviewed by the Emission Standards Division of the Office of Air Quality Planning and Standards, EPA, and approved for publication. Mention of trade names or commercial products is not intended to constitute endorsement or recommendation for use. Copies of this report are available through the Library Services Office (MD-35), U. S. Environmental Protection Agency, Research Triangle Park, NC 27711. (919) 541-2777, or from National Technical Information Services, 5285 Port Royal Road, Springfield, VA 22161, (703) 487-4650.

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

TABLE OF CONTENTS (continued)

LIST OF FIGURES

LIST OF FIGURES (continued)

LIST OF TABLES

LIST OF TABLES (continued)

LIST OF TABLES (continued)

LIST OF TABLES (continued)

LIST OF TABLES (continued)

LIST OF TABLES (continued)

LIST OF TABLES (continued)

LIST OF TABLES (continued)

LIST OF TABLES (continued)

LIST OF ACRONYMS AND UNITS OF MEASURE

a.c.	alternating current
acfm	actual cubic foot (feet) per minute
acmm	actual cubic meter(s) per minute
ADMBP/d	air-dried megagram(s) of bleached pulp per day
ADMP	air-dried megagram(s) ton of pulp
ADMUP/d	air-dried megagram(s) of unbleached pulp per day
ADTBP/d	air-dried ton(s) of bleached pulp per day
ADTP	air-dried ton(s) of pulp
ADTUP/d	air-dried ton(s) of unbleached pulp per day
APCD	air pollution control device
As	arsenic
Be	beryllium
BLO	black liquor oxidation
BLRBAC	Black Liquor Recovery Boiler Advisory Committee
Btu/lb	British thermal unit per pound
$Ca(OH)_2$	calcium hydroxide
CAA	Clean Air Act as amended in 1990
$CaCO_3$	calcium carbonate
CaO	calcium oxide
Cd	cadmium
CEM	continuous emission monitor
CFR	Code of Federal Regulations
cm	centimeter(s)
Co	cobalt
CO	carbon monoxide
CO_2	carbon dioxide
Cr^2	chromium
CRF	capital recovery factor
CS_2	carbon disulfide
d/yr	day(s) per year
d.c.	direct current
DAC	direct annual cost(s)
DAS	data acquisition system
DCE	direct contact evaporator
DMF	N,N-dimethylformamide
EMTIC	Emission Measurement Technical Information Center
EPA	U. S. Environmental Protection Agency
ESP	electrostatic precipitator
FID	flame ionization detector
ft	foot (feet)
ft^2/1,000 acfm	square foot (feet) per 1,000 actual cubic feet per minute
ft^2	square foot (feet)
FTIR	fourier transform infrared
g/L	gram(s) per liter
g/dscm	gram(s) per dry standard cubic meter
gal	gallon(s)
gal/acf	gallon(s) per actual cubic foot
gal/yr	gallon(s) per year
GC	gas chromatography
GFC	gas filter correlation
gpm	gallon(s) per minute
gr/dscf	grain(s) per dry standard cubic foot

H_2O	water
H_2S	hydrogen sulfide
HAP	hazardous air pollutant
HCl	hydrochloric acid
Hg	mercury
HOMER	hazardous organic mass emission rate
hp	horsepower
hr/d	hour(s) per day
HSCSST	heated summa canister source sampling train
HVLC	high-volume, low-concentration
HWI	hazardous waste incinerator
IAC	indirect annual cost(s)
IMS	ion mobility spectroscopy
in.	inch(es)
in. H_2O	inch(es) of water
ITAC	incremental total annual cost(s)
KCl	potassium chloride
kg BLS/d	kilogram(s) of black liquor solids per day
kg/ADMP	kilogram(s) per air-dried megagram of pulp
kg/Mg	kilogram(s) per megagram
kg PM/MWh	kilogram(s) of PM per megawatt-hour
kJ/kg	kilojoule(s) per kilogram
kW	kilowatt(s)
kWh	kilowatt-hour(s)
L/min	liter(s) per minute
L	liter(s)
L/yr	liter(s) per year
L/acm	liter(s) per actual cubic meter
L/G	liquid-to-gas
lb PM/MM Btu	pound(s) of PM per million Btu
lb BLS/d	pound(s) of black liquor solids per day
lb/gal	pound(s) per gallon
lb/ADTP	pound(s) per air-dried ton of pulp
lb/ton	pound(s) per ton
LOQ	limit of quantitation
LVHC	low-volume, high-concentration
m_2	meter(s)
$m^2/(m^3/sec)$	square meter(s) per cubic meter per second
m^2	square meter(s)
m^3	cubic meter(s)
m^3/sec	cubic meter(s) per second
MACT	maximum achievable control technology
MEE	multiple-effect evaporators
mg	milligram(s)
Mg/yr	megagram(s) per year
min	minute(s)
MJ/yr	megajoule(s) per year
ml	milliliter(s)
mm Hg	millimeter(s) of mercury
MM Btu/yr	million Btu per year
MM	million(s)
Mn	manganese
MSD	mass selective detector
MST	Methanol Sampling Train
MWI	medical waste incinerator
Na_2CO_3	sodium carbonate

Na_2S	sodium sulfide
$Na_2S_2O_3$	sodium thiosulfate
Na_2SO_4	sodium sulfate
NaCl	sodium chloride
NaOH	sodium hydroxide
NCASI	National Council of the Paper Industry for Air and Stream Improvement, Inc.
NCG	noncondensible gases
NDCE	nondirect contact evaporator
NESHAP	national emission standards for hazardous air pollutants
ng	nanogram(s)
Ni	nickel
NO_x	nitrogen oxides
NSPS	new source performance standards
NSSC	neutral sulfite semichemical
O_2	oxygen
OAQPS	Office of Air Quality Planning and Standards
Pb	lead
PCDD/PCDF	polychlorinated dibenzo-p-dioxins and dibenzofurans
PM	particulate matter
ppb	part(s) per billion
ppm	part(s) per million
ppmdv	part(s) per million dry volume
ppmv	part(s) per million by volume
QA/QC	quality assurance/quality control
RRF	relative response factor
Sb	antimony
SCA	specific collecting area
SDT	smelt dissolving tank
Se	selenium
sec	second(s)
SIE	specific ion electrodes
SO_2	sulfur dioxide
T-R	transformer-rectifier
TAC	total annual costs
TCI	total capital investment
TDS	total dissolved solids
THC	total hydrocarbon
Tl	thallium
ton/yr	ton(s) per year
TPIEC	Texas Paper Industry Environmental Committee
TRS	total reduced sulfur
TSD	technical support document
µm	micrometer(s)
UV	ultraviolet
VOC	volatile organic compound

1. REPORT NO.	2.	3. RECIPIENT'S ACCESSION NO.
EPA-453/R-96-012		

4. TITLE AND SUBTITLE	5. REPORT DATE
Technical Support Document: Chemical Recovery Combustion Sources at Kraft and Soda Pulp Mills	October 1996
	6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S)	8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS Office of Air Quality Planning and Standards U. S. Environmental Protection Agency Research Triangle Park, NC 27711	10. PROGRAM ELEMENT NO.
	11. CONTRACT/GRANT NO. 68-D1-0115
12. SPONSORING AGENCY NAME AND ADDRESS Office of Air and Radiation U. S. Environmental Protection Agency Washington, D.C. 20460	13. TYPE OF REPORT AND PERIOD COVERED Interim Final (1991-1996)
	14. SPONSORING AGENCY CODE

15. SUPPLEMENTARY NOTES

16. ABSTRACT

National emission standards for hazardous air pollutants (NESHAP) are being proposed for the pulp and paper industry under authority of Section 112(d) of the Clean Air Act as amended in 1990. This technical support document provides technical data and information such as industry and equipment descriptions, analyses of effectiveness and costs of emission control systems, and estimates of environmental impacts of emission control options, that were used in the development of the proposed NESHAP for chemical recovery combustion sources at kraft and soda pulp mills. A NESHAP for noncombustion sources in the pulp and paper industry is being developed concurrently, and information on these sources is contained in separate documents.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS		b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
black liquor	lime kiln	NESHAP	
black liquor oxidation	particulate matter	air pollution control	
chemical recovery	recovery furnace	pulp and paper mills	
combustion source	smelt dissolving tank		
hazardous air pollutants	soda pulp mill		
kraft pulp mill			

18. DISTRIBUTION STATEMENT	19. SECURITY CLASS *(Report)*	21. NO. OF PAGES
Unlimited	Unclassified	471
	20. SECURITY CLASS *(Page)*	22. PRICE
	Unclassified	