HALON & CFC DESTRUCTION, RECOVERY, RECYCLING, AND RECLAMATION TECHNOLOGIES

Ted A. Moore and T. **D.** McCarson
Center for Global Environmental Engineering Technologies
New Mexico Engineering Research Institute
University of New Mexico
Albuquerque, New Mexico
(505) 768-7532

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ABSTRACT

The presentation outlines the latest issues associated with halon and chlorofluorocarbon (CFC) and recovery, recycling, reclamation, and destruction technologies. The results of **a** recently completed market survey **of** available equipment are also presented. The survey was conducted, under United States Air Force sponsorship, **to** identify commercially available equipment and services for recovery of chlorofluorocarbons **(CFCs),** halons, and related alternative materials. The results have been documented in a report which included **(1)** name, address, and telephone number for vendors; (2) price and a description **of** the systems; (3) performance data such **as** discharge and recharge rates, weight, dimensions, and compatible halocarbons; **(4)** description of the halocarbon purification systems, what contaminants can be removed, and how punty can be verified; (5) training availability and adequacy of operation and maintenance documentation; and (6) data indicating system maturity and reliability including historical data on number of systems in use. The report **also** included an evaluation of the available manufacturers, equipment, and the issues related to halocarbon recovery, recycling, and reclaiming with recommendations. Thirty four companies offering **54** different pieces of equipment and/or services were documented.

LAWS AFFECTING CFCs and HALONS

- Montreal Protocol
  - Then
  - Now
- Clean Air Act 1990 - Title VI
- OMNIBUS Budget Reconciliation Act of 1989
- DoD Action
  - Defense Authorization Act for FYs 90/91 Sec 356
  - DoD Directive 6050.9
  - AFR 19-15
- SARA Title III

MONTREAL PROTOCOL

- Negotiated by United Nations in Sep 87
  Senate ratified Dec 88
  Entered into Effect Jan 89
- Controls Production/Consumption of Ozone Depleting Compounds (ODCs)
- Periodic Reassessments
  Based on scientific, environmental, technical and economic information.
  Committees formed and reports published
  - 1989 Complete
  - 1991 In process
- Renegotiated June 1990 in London

CONTROLLED SUBSTANCES

- CFCs-11, -12, -113, -114, & -115
- Halons 1211,1301,2402
- Carbon tetrachloride (CC-10)
- Methyl chloroform (HCFC-140a)
- All fully halogenated fluorocarbons
- HCFCs - (several alteratives to current CFCs)

CLEAN AIR ACT 1990
Title VI

- **CHEMICALS AND PHASEOUT SCHEDULES MATCH OR EXCEED CURRENT PROTOCOL**
- **MAKES EXEMP**

  ti Safety cal Devices, **lational Security,** Developing **Countries, Fire** [] **si & Explosion Pre Generally regarded as "essential uses."**
- REQUIRES **PROD T LABELIN**
- **TES NONESSENTIAL** USES
- **ONTROLS EMISSI** (RECOVERY/**RECYLE**)

CAA 1990 · TITLE VI

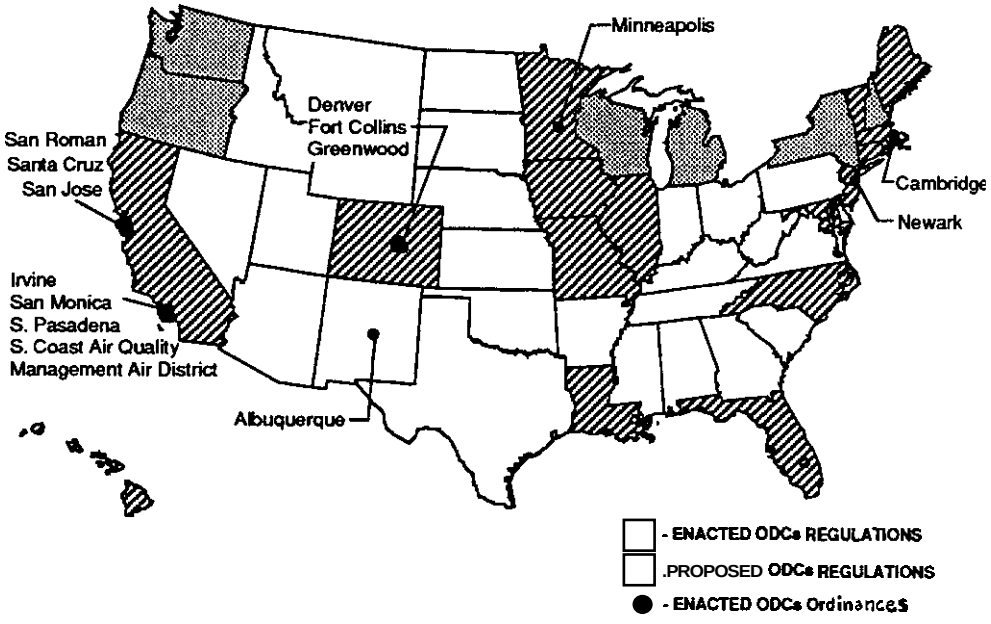
NATIONAL RECYCLING AND EMISSION REDUCTION PROGRAM

- Jan 1992 · Requires Certified MAC service techs to use "approved" R/R equipment for Class I & II Sub.
- July 1992 · Regulations restricting service and disposal of Class I Substances to "Lowest Achievable Emissions Level" also requires R/R
- July 1992 · Venting Class I & II Substances used as refrigerant during appliance service, repair, or disposal prohibited.
- Jan 1995 · Regulations for use and disposal of Class II Substances.
- Jan 1995 · Venting Class I & II Substances and their substitutes prohibited; mandatory R/R/R or destruction.

OMNIBUS BUDGET RECONCILIATION ACT OF 1989

- New Taxes on CFCs and Halons (gov. not exempt)
- CFCs: 1990/91 · $1.37/lb XODP
  1992 · $1.67/lb X ODP
  1993/94 · $2.65/lb X ODP
  1995 and beyond add **$0.45/lbxODP/yr**
- Halons: 1991-93 · **$0.25/lb X** ODP
  1991 add $2.65/lbxODP
  H 1211 · **$ 8.00/lb**
  H 1301 · $26.50/lb
  1995 and beyond add $0.45/lbxODP:
  H 1211 · **$1.35/lb/yr**
  H 1301 · **$4.50/lb/yr**

STATE AND LOCAL LEGISLATION
Taking Aim At Ozone Depleting Chemicals (ODCs)



STATE LEGISLATION SUMMARY

State	Foam	CFC R/R		AC Ban	Container Ban
		Mobile	Fixed		
CA		X	X		X
CN	X	X	X		X
CO			X		
HI		X	X		X
IA	X				
IL		X	X		
FL		X			
LS		X	X		
ME	X	X		X	X
MN		X			X
MO	X				
NY		X	X		X
NC	X				
RI					X
OR	X	X			X
VT		X	X	X	X
WI		X	X	X	X

SEARCH FOR ALTERNATIVES

- UNEP (United Nations Environment Program
  6 technical reports, reassessment in process)
- PAFTT (Program for Alternative Fluorocarbon Toxicity Testing - I, II, III, & IV)
- AFEAS (Alternative Fluorocarbon Environmental Studies - 14 Companies)
- ICOLP (Industry Cooperative for Ozone Layer Protection - 11 companies 7 cleaning projects)
- DOD, EPA, INDUSTRY (Reviewing MILSPECS and MILSTDS. Numerous alternative chemicals research programs)
- ASHRAE, ARI, EPA, SAE, and DOE (Reviewing existing systems, guidelines, and impacts.)

MILSPECS and MILSTDS

20 - Halons
118 - Refrigerants
178 - Solvents
1 - Foams
7 - Propellants
1 - Medical

RESEARCH OBJECTIVES

- Identify Commercially Available Equipment and Services
- Document Existing Information
- Discuss Applicable **Issues**
- Summarize Technologies and Provide Recommendations

ODC USES EVALUATED

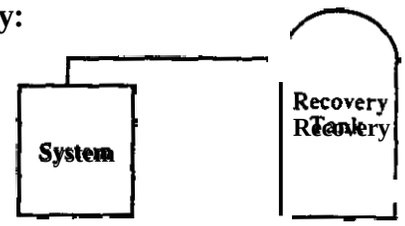
- Refrigeration and Air Conditioning
  - C FCs 11, 12, 113, 114, 115, 500, and 502
  - HCFCs (new alternatives)
  - Mobile and Fixed Systems
- Halon Fire Extinguishants
  - Halons 1011,1211,1301, and 2402
  - Portable Extinguishers and Total Flood Systems
- Solvents
  - CFCs 113, 10, 140a
  - HCFCs (new alternatives)
  - Batch and Continuous Systems

ESTIMATED GLOBAL ODCs CONTRIBUTION TO OZONE DEPLETION BY APPLICATION

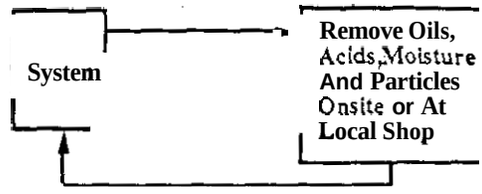
Application	Usage,%	Usage Adjusted for ODP,%
Refrigeration	34	21
Auto AC	13	19
Foam Products	18	26
Solvent	16	19
Polymer	11	2
Medical	2	3
Aerosol	2	3
Fire Extinguishants	4	7

DEFINITIONS

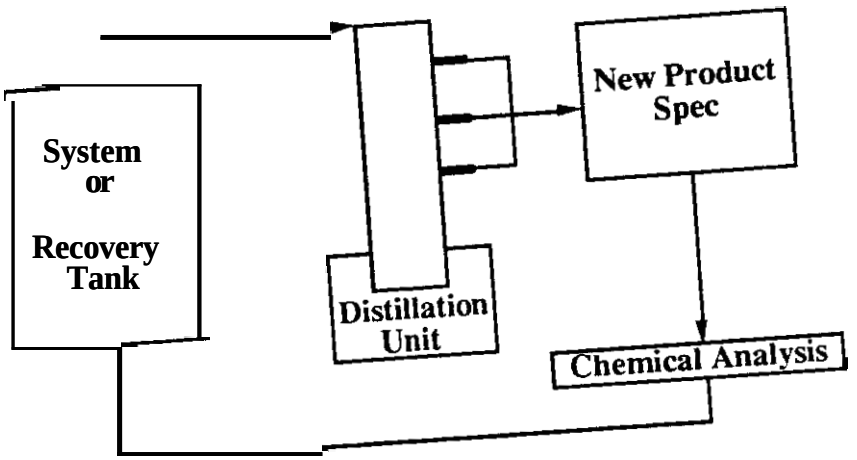
Recovery:



Recycle:

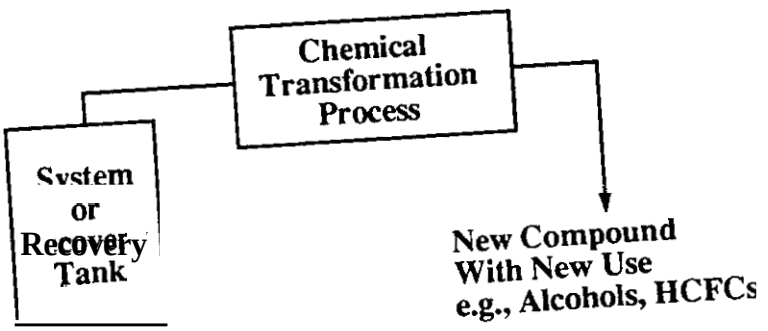


DEFINITIONS (Continued)



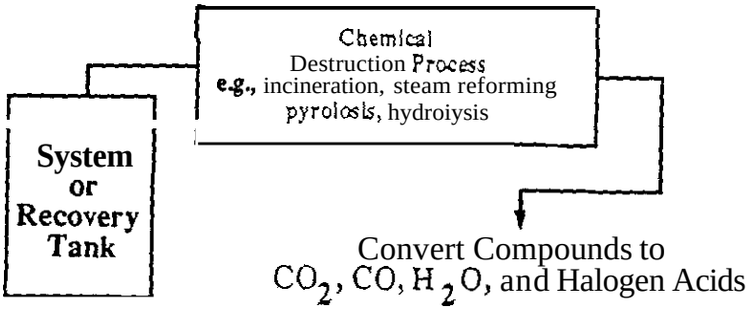
DEFINITIONS (Continued)

Remanufacture:



DEFINITIONS (Concluded)

Destruction:



REGULATIONS, STANDARDS, SPE(ICATIONS, AND GUIDELINES FOR R R

- ARI
  - K-1990 - Container standard for recovered CFCs
  - 700-88 - Specifications for fluorocarbon refrigerants
- ASHRAE
  - Guideline 3-1990 for reducing CFC emissions
- SAE
  - 1989 - Recommended service procedures for MACs
  - 1990 - R/R Equipment for mobile air conditioners
  - 1991 - Purity standards lor mobile air conditioner systems
- UL
  - 1963 - Refrigerant recovery, recycle, and reclaiming equipment for MACS
  - 2006 - Halon *121* recovery, recycle, and reclaiming equipment

R/R/R MARKET SURVEY

- Contaminants Include
  - Particles
  - Moisture
  - Oils
  - Acids
  - Non-Condensible Gases
- Types of R/R/R Equipment and Services
  - Fixed - Usually Reclaim Technology
  - Portable - Recovery and Recycle Technology

Category	Equipment	UL Listed	In Process	Services
CFCs	51 (32 Co)	24	4	5
Halons	3 (5 Co)	-	2	2
Solvents	>10 (10 Co)		-	5

CONCERNS

- General
  - Cross Contamination of Chemicals
  - Reliability of Equipment
  - Purity Requirements
  - Specification Attainment
- Industry
  - Refrigeration and Air Conditioning
  - Foam
  - Aerosol and Sterilants
  - Solvents
  - Fire Protection
- Safety Issues
- Residue Issues
- QA/QC Issues

DESTRUCTION TECHNOLOGIES

ESTABLISHED

- **Incineration - High fuel consumption, costs, and emissions.**
- **Biodegradation - Slow.**

EMERGING

- **Steam Reforming - Low emissions and cost; commercial unit available for testing.**
- **Plasma Pyrolysis - Low emissions; prototype commercial unit available for testing.**
- **Ozonolysis - Prototype commercial unit available for testing.**

DESTRUCTION TECHNOLOGIES (Cont.)

POTENTIAL

- **Supercritical Water Oxidation - LANL**
- **Hydrolysis**
- **Catalytic Dehydrohalogenation**
- **Electron Beams and Water - LANL**
- **Microwave**
- **Destruction using Quicklime** (?)

CONCLUSIONS

R/R/R

- **Comercial Equipment & Services Are Available**
- **Many Factors Influence Purchase Decisions**
- **Traditional Methods Require Significant Change**
- **Determine Purity Requirements**
- **Assess Impact on Organization (Budget Requirements)**

DESTRUCTION

- **High Costs**
- **Loss of Valuable Resource**
- **Emerging Technologies Require Additional Research**

DEVELOP WORLDWIDE, NATIONAL, & COMPANY BANK MANAGEMENT PROGRAMS