Refrigerant Recovery, Recycling, Reclamation and Disposal

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Outline

• Background
• Methodology
• Refrigerant conservation and destruction
• Survey results
• Emission reductions/environmental benefits
• Summary
Study objectives

• To document and compare refrigerant R/R/R/D policies, practices and plans in major markets
  • Asia
  • Europe
  • N. America
• To quantify emission reduction impacts and compare/contrast effectiveness of approaches
Scope

- Phase 1: R/R/R
  countries: AU, CA, FR, JP, NL, US
- Phase 2: R/R/R/D
  countries: plus DK, DE, IT, NO, NZ, CH
Methodology

• Identify key references and information sources
• Establish a Technical Advisory Group
• Develop a questionnaire for relevant input
• Identify gaps in responses
• Analyse results and develop useful format for comparison of data
• Organise international workshop to discuss results
• Report results
Refrigerant conservation

- Containment
  - design
  - installation
  - operation
  - servicing
- Recovery, recycling, reclamation
- Disposal
Refrigerant destruction

- Regulations
- Potential for ODS destruction
Potential for CFC destruction by region

Year

Potential for CFC Destruction (tonnes)

Europe
US
Japan
Other Countries
Destruction technologies

- Incineration (predominant)
  - 1200 °C (ODS/PCB)
  - efficiency 99.999%
  - toxic substances in trace quantities
  - gas scrubber (acid gas)
- Plasma
  - high temp. (5000 - 30000 °C)
  - near-atmospheric pressure
- Reactor cracking
Survey objects

- Standards/regulations in place; enforcement level
- Control organisation
- Finance arrangements
- Applications covered
- Programme element requirements:
  - certification
  - servicing practice
  - training/education
  - inspection
  - documentation
  - penalties etc.
Results R/R/R (1)

Some commonality in measures adopted by various countries, plus some essential differences in approach:

- EU countries, mandatory regulation 2037/2000
- majority programs similar to Australian model
- prohibition of release of ODS and requirement for R/R/R
- certification requirements in most countries, except DE

Different approaches taken to avoiding emissions:

- focus on technical improvements in design and installation (NL)
- stewardship throughout lifecycle, content labelling, take back obligations, training personnel, destruction requirements etc.
Results R/R/R (2)

Different administrative approaches in various countries:

- **USA/Canada**
  - closely controlled government programme
  - mandatory regulations, with enforcement
  - certification required for service technicians, equipment/ownership, reclaimers
  - penalties for non-compliance

- **Netherlands**
  - industry associations took responsibility for compliance
  - self-supporting STEK program (certification/training)
  - mandatory enforced regulations
Results R/R/R (3)

- **Australia**
  - industry initiative > Refrigerant Reclaim Australia
  - importers, wholesalers, manufacturers and contractors
  - collection, recycling/reusing, reclamation and destruction
- Most R/R/R programs surveyed are similar
- **Italy** - no government support funds
- **Japan** - voluntary program replaced by mandatory recovery/disposal program with close government control (2001)
- **France** - Existing decrees supplemented with new regulation
Results refrigerant disposal (1)

- Regulation of ODS adopted in EU
- Refill ban CFCs regulated for most countries, except US and NZ
- Disposal programs in 6 (out of 12) countries surveyed
  - industry-managed/funded by levies on new refrigerant sale (AU, CA, DK, NO, NZ)
  - control by Ministry (JP)
  - details about operation of disposal programs available from CA and AU
Results refrigerant disposal (2)

- Mostly domestic destruction facilities (except NZ, IT)
  - ODS
  - other substances
- Quantities processed annually > 3,300 tonnes
- Estimated cost
  - no access/proprietary
  - UNEP indication
    - USD 3-5 per kg (rotary kiln)
    - USD 3-4 per kg (plasma)
    - USD 4-6 per kg (reactor cracking)
Environmental benefits

Hardly official monitoring results available to compare emission reductions before and after start of refrigerant containment programmes.

Some estimates of refrigerant recovery rates:

- AU - 400 t/y recovered (300 t recycled)
- FR - 650 t/y reclaimed
- JP - 603 t CFC recovered in ‘01 from domestic appliances
- DK - 56 t ODS in ‘98 (39 t destroyed)
- NO - 550 t CFC recovered (85% incinerated)
Emission reductions - Netherlands

Some leakage measurement results reported in 1995 for typical sample of units in specific sectors:

- Transportation refrigeration (>650 units monitored): 6% of charge down to 3% annually
- Supermarket refrigeration (75 units monitored): 15% of charge down to 3% annually
- Fifteen sectors monitored in 1999, excluding automotive AC and marine: 4-5% (equals 615 t (H)CFCs and HFCs - 8% of stock):
  - refrigeration 5.6%
  - freezers 4.5%
  - air conditioning 2.5%

Automotive AC 9% in 1999 (older installations 13%)
Cost benefits

Very little data available except for information in Regulatory Impact Analysis conducted for EPA (US):

- **Costs** included labor involved in R/R/R operations, certification for technicians and equipment, storage of unused CFCs and administration
- **Benefits** based on social aspects, i.e. avoidance of skin cancers and fatalities (between $3M and $12M)
- Computer projections for period 1994-2015: Total estimated costs of $1.28B and benefits ranging from $420M up to $1.69B
Summary (1)

- All twelve countries surveyed have national R/R/R programmes and policies in place
- Ten countries have disposal programs in force or planned - mostly specific to CFC destruction
- Most disposal programs financed by levies on sale of ODS
- Incomplete information on amount of CFC recovered and destroyed
- Estimated 8,800 t destroyed in 2002 likely represents only 2.6% of total global CFC releases
Summary (2)

• Predominant destruction technology: HT incineration
• Broad variations in approaches to:
  • leakage reduction
  • organization/control/funding mechanisms
  • responsibility levels
  • regulatory legislation requirements
• Emission reductions:
  • hardly official monitoring of before/after effectiveness
  • strong evidence of reduced leakage rates and increased quantities of recovered refrigerants