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## ENFORCEMENT OF CHLOROFLUOROCARBONS REGULATIONS ON MARITIME VESSELS

KLINGENBERG, ALBERT

VROM INSPECTORATE, SOUTH-WESTERN REGION; Weena 723; P.O. Box 29036; 3001 GA Rotterdam; Tel: +31 (0)10 224 4444; albert.klingenberg@minvrom.nl

### SUMMARY

Inspections conducted by the VROM Inspectorate between 1996 and 2001 revealed that refrigeration installations on board both merchant vessels and trawlers have an average annual leakage of hydrochlorofluorocarbons (refrigerants) in the order of 50%. Among smaller fishing vessels ('cutters'), this figure rose to 80%. The policy of the Netherlands Ministry of Housing, Spatial Planning and the Environment (VROM) is that refrigerant leakage should not exceed 0.1-1% per annum. Refrigeration equipment on board vessels operating under the Dutch flag accounts for only 5% of the total quantity of refrigerants in use in the Netherlands, but is responsible for 35% of the total emissions of these substances. Clearly, the shipping industry makes a disproportionately large contribution to the emission of substances which deplete the ozone layer and exacerbate the greenhouse effect. The high leakage rate is due to a number of causes. The Dutch government has called upon the shipping industry to take corrective measures. In the past year, the VROM Inspectorate has conducted further inspections of maritime vessels and will continue to do so in 2005 as a matter of increased priority. The objective of these inspections is to ensure that operators comply with all legislation covering the use of hydrochlorofluorocarbons, and that refrigerant leakage is drastically reduced.

### 1 INTRODUCTION

Since the 1990s, the VROM Inspectorate has been responsible for regulating compliance with legislation covering the use of hydrochlorofluorocarbons in refrigeration equipment on land. If released into the atmosphere, these refrigerants deplete the ozone layer and have an adverse effect on the climate. In the late 1990s, it became increasingly clear that refrigeration equipment on board maritime vessels was a hitherto under-recognized source of hydrochlorofluorocarbon leakage. Fishing vessels with installations for refrigerating the catch were identified as a particular problem, although merchant vessels also account for disproportionately high leakage.

In April 2000, the Netherlands Min-

istry of Housing, Spatial Planning, and the Environment (VROM) Inspectorate published a report further to the inspections conducted the previous year.<sup>1</sup> This publication describes the leakage rate of refrigeration installations on board vessels operating under the Dutch flag. It concludes that the leakage rate of the fishing fleet during the period 1996 to 1998 was some 80%, while that of merchant vessels was in the order of 50%. The policy of VROM states that refrigerant leakage should not exceed 0.1-1% per annum.

### 2 TARGET GROUP

The Dutch fishing industry has four large operators with a combined fleet of approximately sixteen trawlers sailing under the Dutch flag. Trawlers are fitted

with several large refrigeration installations, the refrigerant capacity varying from a few tens of kilograms (kg) to several thousand kilograms. There are also approximately 420 smaller 'cutters' sailing under the Dutch flag. These vessels usually carry one or more refrigeration installations containing some 10 kg of refrigerant, as well as an interior climate control installation containing approximately 25 kg of refrigerant. The Dutch merchant fleet comprises approximately 1000 vessels carrying refrigeration equipment.

### **3 INSPECTIONS IN 2002 AND 2003**

The inspections were carried out again in 2002 and 2003, resulting in a further report published in June 2003.<sup>2</sup> The conclusions are that in the period 1996 to 2001 (the earlier results from 1996-1998 were also analysed), the refrigeration equipment on board both merchant vessels and trawlers showed an average annual refrigerant leakage of 50%. Among the cutters, the figure was 80%.

To place the extent of hydrochlorofluorocarbon emissions into perspective, we may state that the trawlers accounted for emissions of almost 182,000 kg, from a total refrigerant content of over 307,000 kg in 45 refrigeration installations on board 15 trawlers, resulting in a leakage rate of approximately 59%.

The study also sought to determine whether there are any vessels with refrigeration equipment which does not account for any hydrochlorofluorocarbon emissions. This proved not to be the case. Only a very few vessels can claim a refrigerant leakage of less than 10%. In 2003, the VROM Inspectorate instigated legal proceedings against two trawler operators responsible for excessive leakages. The case has yet to be heard.

### **4 COMPARISON WITH OTHER REFRIGERATION EQUIPMENT**

In the case of refrigeration equipment on land, legislation, enforcement, and the efforts of the relevant industries have

served to reduce the annual leakage from a double-figure percentage to approximately 4.5%. Because the shipping industry has yet to achieve a similar reduction, it now accounts for a disproportionately large share of refrigerant emissions. Refrigeration installations on board vessels operating under the Dutch flag contain only 5% of the total quantity of refrigerants in use in the Netherlands, but contribute 35% of the total emissions. It will be clear that the shipping industry makes an unacceptably large contribution to the release of substances that deplete the ozone layer and exacerbate the greenhouse effect.

### **5 CAUSES**

It may be assumed that the high leakage rate is partly attributable to the refrigeration equipment's inability to withstand the specific conditions at sea, such as a corrosive salt-laden atmosphere, vibrations and torsion. The causes may also include poor maintenance, the failure to detect leaks, the age of the equipment in use, the technology employed, and the manner in which legislation has been enforced to date. The sheer complexity of the equipment is also an important factor.

### **6 MEASURES**

The Dutch government has instructed the shipping industry to take appropriate measures as a matter of urgency. Such measures relate to the operation and maintenance of the equipment in use, the introduction of formal maintenance systems, increased awareness on the part of crew members, and the improvement of leakage detection systems. Alongside these measures, further action can be taken in the case of newly constructed vessels, which can be required to install indirect rather than direct refrigeration systems, to replace synthetic refrigerants with natural alternatives, and to apply the principles of Life Cycle Engineering within the design of refrigeration installations.

## 7 INSPECTIONS IN 2005

The VROM Inspectorate has conducted further inspections on board sea-going vessels during the past year and will continue to do so in 2005 as a matter of increased priority. The objective is to ensure that the operators concerned comply with the legislation covering the use of hydrochlorofluorocarbons, and that refrigerant leakages are drastically reduced.

## 8 REFERENCES

- <sup>1</sup> 'Hoe de scheepvaart het lek boven water houdt' ('How the shipping industry keeps on top of things'), VROM Inspectorate, 2000.
- <sup>2</sup> 'Koudemiddelen het schip in' ('The trouble with refrigerants'), VROM Inspectorate, 2003.