UNIVERSIDADE DE SÃO PAULO

INSTITUTO DE FÍSICA
CAIXA POSTAL 20516
01498-970 SÃO PAULO - SP
BRASIL

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REDUCING CFC EMISSIONS: THE DIFFICULT TASK OF MONTREAL PROTOCOL IMPLEMENTATION

Suely M. Machado Carvalho

Instituto de Pesquisas Energéticas e Nucleares, CNEN
CP 11049, 05422-970 São Paulo, SP, Brazil

and

Grupo de Estudos de Poluição do Ar
Instituto de Física, Universidade de São Paulo

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Suely M. Machado Carvalho

Instituto de Pesquisas Energéticas e Nucleares, CNEN
CP 11049, CEP 05422-970
São Paulo, Brazil

and

Grupo de Estudos de Poluição do Ar
Instituto de Física, USP
CP 20516, CEP 01498-970
São Paulo, Brazil

ABSTRACT Montreal Protocol implementation programs are not a straightforward task in developing countries as it may seem to the developed world. Marketing is the driving force in Brazil and the exporting characteristics of the Brazilian Industry force phase-out to match developed world schedule despite of the grace period allowed. Nevertheless, the lack of a national well established infrastructure to follow closely the process poses a risk to the implementation plan. Leadership is not well defined to the interested sectors trying to have access to the information and financial support available from the Multilateral Fund. Regulatory agencies do not have the action programs defined to ensure enforcement. The actual social and economical situation of the country makes it difficult to set priorities concerning the CFC issue especially when availability of qualified personnel is a must. The National Planing Program for the Protocol implementation is still being prepared. Unfortunately, the lack of adequate representativeness of all industry sectors involved and proper interface with the Government hinders the process. Starting a National Task Group Office and investing in education and training are also necessary tools to patch some of the"holes".

BRAZILIAN SCENARIO

Brazil falls into the category of developing country under the article 5 of the Montreal Protocol. With less than 0.07 kg per capta consumption of ODS substances, Brazil is one of the largest producer and user of Ozone Depleting Substances (ODS) in Latin America. Brazil is self sufficient in CFC-11, 12, and HCFC-22, but the production of CFC-113 and 114 does not meet the current country demand, being therefore imported. Only two companies are producers of CFC-11, 12, 113, 114 and HCFC-22 in Brazil: DuPont do Brasil and Hoechst. According to Hoechst, the production of CFC-113 has stopped (Hoechst, 1992). Total installed capacity equals to about twice actual demand. Brazil exports CFC-11, 12 and HCFC-22 to Latin American countries. Figure 1 shows the CFCs consumption by end-use (DuPont, 1992). There was a small decrease in the total CFC demand going from 10,000 metric tons (MT) in 1991 down to 8,200 MT in 1992. HCFC-22 consumption in 1991 amounted 3346 MT. Halons are imported and the 1991 consumption of halons in the country amounted to 46 MT (DuPont, 1992).

Carbon tetrachloride is locally produced by Dow Chemical and Rodhia. In 1991, around 97% of the total internal demand (14,000 MT) was used as feedstock for fluorocarbons production (Dow, 1992).

Presently, all the Brazilian demand of Methyl Chloroform is supplied through importation, which represents an average of 10,000 MT on 1991 basis. Dow estimates to have 70 to 80% of total market share. Close to 85% of total MCF sold in Brazil is designed to industrial material surface cleaning application. The remaining 15% is basically used in formulations. Metallurgical, auto parts and automotive assembling industries are responsible for almost all MCF used in material surface cleaning.

GENERAL DESCRIPTION OF THE SECTORS

Refrigeration is the largest CFC use sector in Brazil. Domestic market is far from being saturated, with 35% of homes not having refrigerators due to low

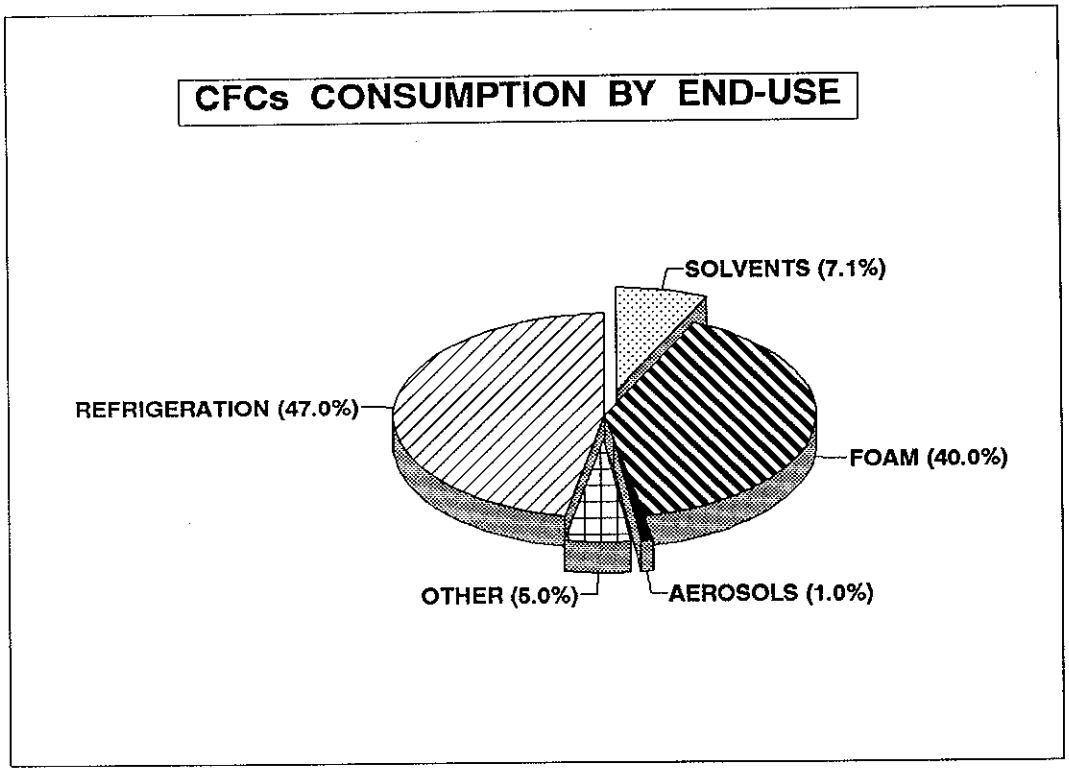

FIGURE 1. CFC's consumption by end-use.

income (close to 12 million families) (ABINEE, 1992a). Food deterioration due to lack of refrigeration causes the loss of roughly 50 tons of food per day in the largest city of the country. Anual consumption of CFC-12 is 4,500 MT and CFC-11, 200 MT. HCFC-22 is largely utilized in commercial refrigeration units and central air conditioning. Automotive, domestic and industrial /commercial refrigeration accounts for 7.0,12.9 and 26.9% of the total CFC consumption in the country respectively. Home appliances represent 17% of the total CFC used in refrigeration and industrial and commercial refrigeration, 15%. Automobile air-conditioning utilizes 9%. Approximately 59% is for recharge of existing equipment (after market) (DuPont, 1992).

Half million of refrigeration systems are serviced every year (ABINEE, 1992a). All the refrigeration components including compressors are produced in Brazil. There are approximately 1,600 domestic refrigeration and window air-conditioning service shops authorized by manufacturers. Independent workers amount to 20,000. Close to 200 automobile air-conditioning shops service the cars in Brazil and another 200 shops install central air conditioners (EMBRACO, 1992). Most of the service workers are trained by factories and other institutions, acquire experience after routine work in the field, but do not have high school education. The commercial refrigeration market is serviced by a small number of technicians and engineers. Their training is usually sponsored by the manufacturers.

Foaming is the second largest CFC use sector in the country. Insulation, flexible foams and packaging, represent 24, 10.0 and 6% respectively of the total CFC consumption in the country. Out of the total CFC used in foams in 1989, 85% was in the polyurethane sector, 12% polystyrene and 3% in the polyethylene sector, demanding 4,000 MT total in that year (DuPont, 1992).

Solvents account for only 7 % of the total consumption in 1989, basically CFC-113. The main areas of application are electronics (62%), metal cleaning (16%), biomedical (14%) and other uses (8%)(DuPont, 1992). Methylchloroform (MCF) demand has decreased since 1986, from 15,600 MT down to about 9,000 MT in 1991 (Dow, 1992). The largest MCF use sector is metal cleaning (82 %) followed by electronic component cleaning (10%) aerosols, adhesives, coatings (5%) and other uses (3%) (Dow, 1992).

Brazilian aerosol industry has switched away from CFC propellants due to strong competition of less costly non-pressurized packaging technologies and more stringent regulations that have banned the use of CFCs in insecticides and

household products since 1979 (M.Saúde, 1979, 1989). Only 1% of the total country CFC consumption is still used as aerosol, under the category of essential uses, mostly medicinal.

ACTIONS TO CONTROL EMISSIONS

When focusing on Ozone Depleting Substances, ODS, reduction in the atmosphere, the areas of opportunity in Brazil are : Recovering and Reclamation, Foaming and Education and Training.

RECOVERING AND RECLAMATION

Conservation and recovery practices can reduce emissions as well as better engineering controls and improved storage and handling procedures.

According to ABRAVA (1992), CFCs actual stock in refrigeration systems in the country amount to 27,400 MT, being 1,900 MT in individual air conditioning units, 2,500 MT in central air conditioning, 8,000 MT in domestic refrigerators and freezers and 15,000 MT in commercial / industrial refrigeration systems. Annual production to cover for after market demand was 5,487 MT in 1991. Only 3,546 MT per year needed for new units. Therefore, proper management of the actual stock and reductions of after market needs are the proper way to handle emissions in the refrigeration sector (Belinky, 1992). In order to attack the problem a project proposal was submitted to the ABINEE Tecnical Group on Chlorofluorcarbons, GT-CFC, and to the Government Task Group on Ozone, GTO in August 1991, establishing a recovering and reclamation network in São Paulo. This city is the largest (15 million inhabitants) in the country. "In loco" treatment of the product (recycling) was disregarded due to the low quality of the purified gas, cost and difficulties concerning availability of equipment for this purpose. Selection and economical feasibility of the recovering equipment, forms of evaluation of the quality of the recovered gas, consumers awareness and an economical viability study were considered to implement the project and to try to obtain financial resources. Unfortunately, difficulties on accessing the MLF and

lack of national resources delayed implementation. The way to force the project ahead was achieved by the cooperative effort between the Sao Paulo State Environmental Agency, CETESB, and an industry alliance (DuPont, Hoechst, CETEST S.A.) with the support of class associations. The cooperation was sealed in February, 1992, and it is estimated that 150 MT of CFC-11 and 12 will be collected from refrigeration systems in the state of São Paulo in the first year, increasing the following years. It is expected that the success of the project will be extended to other states of Brazil. The cost of the reclaimed gas is 50% of the cost of the new product and 70 % of the used gas, can be reclaimed (Belinky and Neulaender, 1991)

Another sector where recovering and reclamation is a must is the MCF one. The economical situation in Brazil with high rate of inflation and unemployment, has led to a decrease in the MCF sold in the country. Still, close to 7,400 MT of MCF were used in metal cleaning in 1991, 82% of the total utilized (Dow, 1992). The lack of an official recovering and reclamation industry make it difficult to control emissions. Recovering has been done by non-authorized shops("pirate") and there is no control of the final disposal of those residues. MCF recovered by authorized companies may also end up in repositories waiting for disposal/destruction. The Sao Paulo State Environmental Agency (CETESB) has not authorized the use of the commercial incinerators existent in Sao Paulo, the largest industrial region of the country. The long interstate transport of chlorinated residues needed to reach the two authorized ones, hinders proper handling of the situation.

FOAMING

Reduction of close to 30% by year 2008, in the use of CFCs in foaming was proposed by ABINEE in the first Brazilian Case-Study submitted to the government in 1989. Laboratory tests are still under way so that rigid foams with 50% less CFCs are produced to supply the refrigeration sector (Sintenor, 1992). Flexible foams users are switching from CFC-11 to methylene chloride, expanded polyestyrene users are changing from CFC-12 to HCFC-22 /hidrocarbons or CO2 (DuPont, 1992). It is expected by the end of 1992 a 30 % reduction of CFCs in foams used in refrigeration (ABINEE, 1992b) Total CFC phase-out schedule in foams has not being informed by the Industry so far.

EDUCATION AND TRAINING

The most important action that can be taken in the refrigeration sector is an awareness and training campaign designed to reach all the service technicians and users. This is because the gas will be collected by the technicians servicing the units, taken to the recovering centers previously established and from there to the recovering Central where the gas will be analyzed and screened before be sent to one of the chemical plants in Brazil (DuPont or Hoechst), to be reclaimed. After reclamation, the gas is given back to the technician or company that collected it.

Investing in information and training in the solvents sector is of utmost importance. Only this investment can assure adequate utilization of the solvent so that reclamation can be more efficient. MCF suppliers and equipment designers and producers have to work together to guarantee adequacy of equipment needs, helping therefore to reduce emissions. It seems that for the MCF sector serious problems will have to be attacked, starting by improving cooperation concerning official information being supplied. One successful CFC elimination program that focused on education and training is the Ford Electronics one. The electronic industry in Brazil uses 62% of the total CFC-113 in the country as solvent. The Ford Electronics, Arbor Plant/Brazil used 186,682 kg of CFC-113 in 1986 and in 1987, consumption peaked at about 220,000 kg, decreasing to about 30,000 kg in 1990. Actual consumption is 21,333 kg. Phase out is expected to happen starting 1993 (FORD, 1992). Reduction was achieved through the conversion of the soldering process to a high solids content no-clean flux (FORD, 1990). Education and training played an important role.

REMARKS AND RECOMMENDATIONS

Phase-out before the year 2000 is more of a market decision than a government one. All points to the direction that Brazil will follow the developed world schedule. The funding mechanisms are already defined but access is

somewhat difficult. Technology is available to the most important sectors that utilize CFCs in Brazil since they need up to date technology and information to compete in the international market. Alternatives production in the country even though announced by Hoechst will have to satisfy three basic conditions: market size that will justify production, selection of alternatives to be produced to attend the market, and the necessary maturation time for the new technologies that will be used and applied.

Despite the Government effort to have the National Program, there is still a lack of information concerning the Protocol mechanisms and main objectives of the Program. A clear definition of responsibilities is still missing. Corresponding legislation has also to be established to implement it.

Monitoring its results can only be achieved with the direct participation of the Industry. The idea of establishing Task Group Offices, discussed in many international meetings seems to be the way to help implementation of the Protocol (Corona, J., 1991, Carvalho, S., 1991a, Carvalho, S., 1991b, Carvalho et al., 1992). The question of utilizing the MLF concerning the installation of a Task Group Office in Brazil has not been clarified.

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