

Assessment on the Level of Implementation of CFCs and HCFCs Montreal Protocol by Refrigeration and Air-conditioning Practitioners in Benue State, Nigeria

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Abstract:- This study assessed the level of implementation of CFCs and HCFCs Montreal Protocol by Refrigeration and Air conditioning practitioners in Benue State. The population of the study comprised of 50 practitioners of refrigeration and air conditioning across the state. A descriptive survey research design was used for the study. The instrument for data collection was a structured questionnaire and data collected was analyzed using descriptive statistics to ascertain the extent to which practitioners in Benue State have implemented CFCs and HCFCs Montreal protocol. The result of the study revealed that refrigeration and air conditioning practitioners in Benue State are aware of CFCs and HCFCs effect on Ozone layer depletion but they are not able to recover and store CFC and HCFC Refrigerants from old refrigerating systems when carrying out repairs. The study recommended among others that refresher trainings should be organized for practitioners.

Keywords:- Refrigeration and Air conditioning; Practitioners; Montreal Protocol; Refrigerants.

I. INTRODUCTION

Human activities since the Industrial Revolution are accountable for steady rises in atmospheric concentrations of numerous greenhouse gases, particularly carbon dioxide and organic chemicals such as chlorofluorocarbons (CFCs) and hydro chlorofluorocarbons (HCFCs). CFCs and HCFCs are refrigerants used in refrigeration and air conditioning systems; and they are Ozone Depleting Substances (ODS) [1]. Chlorofluorocarbons are refrigerants that contain chlorine. They have been banned since the beginning of the 90's because of their negative environmental impacts [2]. The hydrofluorocarbons are refrigerants that contain no chlorine and are not harmful to the ozone layer however; their impact on global warming is very large (Mann, 2019).

According to UNEP[3], The Montreal Protocol entered into force on 1 January 1989 and has since undergone nine revisions; in 1990 (London), 1991 (Nairobi), 1992 (Copenhagen), 1993 (Bangkok), 1995 (Vienna), 1997 (Montreal), 1998 (Australia), 1999 (Beijing) and 2016 (Kigali). The Protocol includes provisions related to Control Measures (Article 2), Calculation of control levels (Article 3), Control of trade with non-Parties (Article 4), Special situation of developing countries (Article 5), Reporting of data (Article

7), Non-compliance (Article 8), Technical assistance (Article 10), as well as other topics [4]. The substances controlled by the treaty are listed in Annexes A (CFCs, halons), B (other fully halogenated CFCs, carbon tetrachloride, methyl chloroform), C (HCFCs), E (methyl bromide) and F (HFCs). Throughout the implementation of the Montreal Protocol, developing countries have demonstrated that, with the right kind of assistance, they are willing, ready and able to be full partners in global efforts to protect the environment. In fact, many developing countries have exceeded the reduction targets for phasing out ODS, with the support of the Multilateral Fund [6]. Montreal Protocol on substances that deplete the ozone layer has developed a phase-out management plan which includes both production and consumption of chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs) [5].

The conversion of equipment and recovery of refrigeration and air conditioning systems using CFCs and HCFCs has not yet been completed; such systems when spoiled are left in the hands of technicians for repairs. Technicians are then required to handle such systems in accordance with the Montreal protocol. This study is focused on the level of implementation of Montreal Protocol by refrigeration and air conditioning practitioners in Benue State.

II. STATEMENT OF THE PROBLEM

Nigeria is not an exception to the global regime for environmental protection of the ozone layer and in order to implement the Montreal Protocol, the Federal Government of Nigeria through the ministry of environment partner with United Nations Development Program (UNDP) through a project managed by the Ozone Program and Management Implementation Unit (OPIAMU) for awareness creation and training of industrial operators that are concerned with CFCs and HCFCs substances. One of the major operators that handle such substances is the refrigeration and air conditioning practitioners; these practitioners are the craft men, technician, technologist and engineers who carry out repairs, maintenance or handle installation of refrigeration and air conditioning equipment, they are directly involved in handling refrigerants that contains CFCs and HCFCs substance. In the year 2008, Refrigeration and Air-conditioners practitioners in Benue State were trained on proper handling of these substances and hence there is a need to assess the level of implementation on the handling of these

substances by the practitioners of the refrigeration and air conditioning in Benue State.

III. RESEARCH QUESTIONS

The following research questions were formulated to guide the study:

- Are the refrigeration and air conditioning practitioners in Benue State aware of CFCs and HCFCs refrigerants' effect on Ozone layer depletion?
- Are the refrigeration and air conditioning practitioners in Benue State able to recover CFCs and HCFCs refrigerants from old systems?
- Are the refrigeration and air conditioning practitioners in Benue State able to store CFCs and HCFCs refrigerants recovered from old systems for proper disposal?

IV. METHODOLOGY

The study adopted a descriptive research design in which information relating to the level of implementation of CFCs and HCFCs Montreal Protocol by Refrigeration and Air-conditioning practitioners in Benue State was sought. Fifty (50) practitioners were sampled from a population of three hundred (300) practitioners in Benue State. The instrument for data collection was a structured interview questionnaire and the questionnaire items were structured into four parts (A, B, C, & D). Part “A” had 5 items on practitioners aware of CFCs and HCFCs effect on Ozone layer depletion; Part “B” 5 items on practitioners ability to recover CFCs and HCFCs

refrigerants from old systems; Part “C” 5 items on practitioners ability to store CFCs and HCFCs refrigerants recovered from old systems for proper disposal; and Part “D” has 5 items on practitioners release of CFCs and HCFCs refrigerants in old systems to the atmosphere during repairs. A five-point response mode of Strongly Agreed (SA), Agreed (A), Strongly Disagree (SD), Disagree (D), and Undecided (UD) with a corresponding numerical response scale value of 5, 4, 3, 2 and 1 was used to illicit information from the practitioners. The questionnaire items were validated by two experts of refrigeration and air conditioning from the department of vocational and technical education, Benue State University, Makrudi.

Data collected from the practitioners were analyzed using mean and standard deviation. The cut off point for taking decision on each item was 3.00. Any item representing a task whose mean was less than 3.00 was regarded as not able to perform the task.

V. RESULTS

The results are presented according to the research questions that guided the study.

- *Research Question 1: Are the refrigeration and air conditioning practitioners in Benue State aware of CFCs and HCFCs refrigerants' effect on Ozone layer depletion?*

The data that answer this research question is presented in table 1 below.

Table 1 Mean rating of refrigeration and air conditioning practitioners’ awareness of CFCs and HCFCs refrigerants' and its effect on Ozone layer depletion.

Test Items	N	SA	A	D	SD	\bar{X}	STD
CFCs and HCFCs are the main Refrigerants Currently Used in refrigeration and Air-Conditioning services in Makurdi Metropolis.	50	23	15	4	8	3.14	0.0190
The ozone layer is essential to the existence of lifeforms on earth.	50	35	13	2		3.66	0.0021
Ozone depletion can affects life forms on earth negatively.	50	31	14	3		3.48	0.0003
CFCs and HCFCs are substances that deplete the Ozone Layer and threaten the existence of life forms on earth.	50	42	6	2		3.80	0.0091
CFCs and HCFCs Refrigerants have positive effects on the Ozone Layer.	50	2	3	2	25	3.36	0.0036
Releasing CFCs and HCFCs into the Atmosphere Causes Damage to the Ozone Layer.	50	38	7	4	1	3.64	0.0015
CFCs and HCFCs refrigerants to are on the Phase out list of Montreal Protocol	50	29	15	3	3	3.40	0.0021
Cluster Mean						3.53	0.2195
Note: N = number of respondent, SA = Strongly Agreed, A=Agreed, D = Disagreed, SD = Strongly Disagreed, \bar{X} = Mean and STD = Standard Deviation							

The data presented in Table 1 shows the mean rating of respondents with regards to awareness of CFCs and HCFCs and its effects on Ozone layer depletion. The data showed that the mean rating of the respondents for test item 1, 2, 3, 4, 5, 6, and 7 are 3.14, 3.66, 3.48, 3.80, 3.82, 3.36, 3.64, and 3.40, respectively. On the basis of the cut-off point of 2.50, all the items indicated that their mean were above 2.50 which

implies that they all agreed to the test items aware of CFCs and HCFCs effects on Ozone layer depletion. The cluster mean of 3.53 was also accepted since it met the cut-off point condition. This implies that refrigeration and Air-Conditioning practitioners in Benue State are aware of CFCs and HCFCs effect on Ozone layer depletion.

- *Research Question 2: Are the refrigeration and air conditioning practitioners in Benue State able to recover CFCs and HCFCs refrigerants from old systems?*

The data that answer this research question is presented in table 2 below.

Table 2 Mean Ratings of refrigeration and Air-Conditioning practitioners in Benue State's ability to recover CFCs and HCFCs refrigerants from old systems

Test Items	N	SA	A	D	SD	\bar{X}	STD
I am able to recover CFCs and HCFCs Refrigerants from Old systems.	50	2	3	7	38	2.14	0.0190
I use recovery pump to recover CFCs and HCFCs Refrigerants from Old Systems.	50	2	1	6	41	2.23	0.0021
I observe safety procedures when recovering CFCs and HCFCs Refrigerants from old systems.	50	2	3	8	37	2.13	0.0091
The procedures I recover CFCs and HCFCs Refrigerants is in line with Montreal Protocol	50	2	3	12	31	2.00	0.0003
Cluster Mean						2.14	0.0012

Note: N = number of respondent, SA = Strongly Agreed, A=Agreed, D = Disagreed, SD = Strongly Disagreed, \bar{X} = Mean and STD = Standard Deviation

Data presented in table 2 shows the mean ratings of respondents with regards to refrigeration and Air-Conditioning practitioner's ability to recover CFCs and HCFCs from old systems. The table revealed that the mean rating for respondents for test item 1 to 4 fails the cut-off point of 2.50; all the items indicated a mean below 2.50 which implies they were all rejected as the refrigeration and air-conditioning practitioners in Benue State are not able to recover CFCs and HCFCs from old systems. This implies that

refrigeration and air conditioning practitioners in Benue State are not able to recover CFCs and HCFCs from old systems.

- *Research Question 3: Are the refrigeration and air conditioning practitioners in Benue State able to store CFCs and HCFCs refrigerants recovered from old systems for proper disposal?*

The data that answer this research question is presented in table 3 below.

Table 3 Mean Ratings of refrigeration and Air-Conditioning practitioners' ability to store CFCs and HCFCs refrigerant recovered from old systems for proper disposal.

Test Items	N	SA	A	D	SD	\bar{X}	STD
After I Recover CFCs and HCFCs Refrigerants from Old Systems, I store in Safety cylinders	50	2	3	10	35	2.00	0.0006
I hand over recovered CFCs and HCFCs refrigerants to ministry of environment for proper disposal.	50	2	1	4	43	1.90	0.0001
I stored recovered CFCs and HCFCs Refrigerants cylinders in a well-ventilated room.	50	2	3	8	37	2.13	0.0004
I do not release CFCs and HCFCs Refrigerants to the atmosphere during repairs of refrigeration systems.	50	2	3	12	31	2.00	0.0003
Cluster Mean						2.02	0.0025

Note: N = number of respondent, SA = Strongly Agreed, A=Agreed, D = Disagreed, SD = Strongly Disagreed, \bar{X} = Mean and STD = Standard Deviation

The data in table 3 shows the mean ratings of refrigeration and Air-Conditioning practitioners' ability to store CFCs and HCFCs recovered from old systems for proper disposal. The Table revealed that the mean rating of the respondents for test item 1 to 4 fails the cut-off point of 2.50, all the items indicated that their mean are below 2.50 which implies refrigeration and air-conditioning practitioners in Benue State are not able to store recovered CFCs and HCFCs refrigerant from old systems for proper disposal.

VI. FINDINGS

The findings from the analysis shows that the Montreal protocol to phase out the use of Ozone depleting substances such as CFCs and HCFCs have not been implemented by refrigeration and air-conditioning Practitioners in Benue State, Nigeria. Practitioners in this specialty are aware of the dangers of CFCs and HCFCs refrigerant to global warming

and ozone layer depletion but they lack knowledge to handle such refrigerants.

The cluster mean of 2.14 in table was rejected since it not met the specified condition of 2.50. This implies that refrigeration and air conditioning practitioners in Benue State are not able to recover CFCs and HCFCs from old systems. This also shows that montreal protocol on recovery and handling of CFCs and HCFCs refrigerants has not been implemented by the practitioners in the state.

VII. CONCLUSION

Refrigeration and Air conditioning Practitioners in Benue State have not implemented the Montreal Protocol on CFCs and HCFCs refrigerants to a very great extent that they do not recover or store the refrigerants from old refrigeration systems during repairs.

RECOMMENDATIONS

Based on the findings of this study, the following recommendations were made:

- Workshops and trainings should be organized yearly by the government and related stakeholders for refrigeration and air-conditioning practitioners as they are directly involved in handling of refrigerants that contain CFCs and HCFCs substance.
- The Government should set-up bodies that will carry out routine checks, supervision and regulate the activities of refrigeration and air-conditioning practitioners comply with Montreal Protocol on CFCs and HCFCs.

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