

A Study of Current Working Practices for Refrigerant Recovery During HVAC Maintenance Work at Hospital Raja Permaisuri Bainun

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Abstract: Compliance with international agreements and regulations aimed at lowering emissions of gases with a high global warming potential (GWP) demands the participation of all stakeholders in the value chain of refrigerant-containing equipment [1]. This study evaluates the current practises for refrigerant recovery during HVAC maintenance work at Hospital Raja Permaisuri Bainun in Ipoh, Malaysia. Edgenta Mediserve technicians responsible for the installation, maintenance, and disassembly of refrigeration equipment are lack of awareness and knowledge related refrigerant recovery. This research presents the survey results of a questionnaires distributed to 20 Edgenta Mediserve technicians in order to evaluate their behaviour, knowledge, and understanding of hazard in relation to refrigerant gases and global warming. Based on the survey and interview results, clearly that technician behaviour and lack of information regarding applicable laws and regulations can significantly contribute to refrigerant emissions. In addition to technical information and training, technicians' awareness of the effects of refrigerant on global warming is essential for refrigerant-related act, regulations, and initiatives. There are needs to implement information or awareness campaigns more efficiently and dependably and to improve the training of these professionals in key respect-related areas, such as the relationship between greenhouse gases and climate change and the significance of individual accountability [1]. Employers must also implement policies and procedures to ensure compliance with applicable laws and regulations. The study recommends the implementation of training programmes and the development of policies and procedures for the handling of refrigerants in order to improve worker proficiency and reduce the risk of environmental damage.

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1. Introduction

CFCs are composed of fluorine, carbon, and chlorine and are mostly applied in the operation of refrigeration units at Edgenta Mediserve. The CFCs applied as refrigerants in Hospital Raja Permaisuri Bainun Ipoh are HCFC and HFC, specifically R-22, R-32, R-134a, R-410 and R-507. The upkeep of the HVAC system in the hospital is essential since some of the units are used for drug storage, corpse cooling, and any cooling needs that cannot be interrupted or delayed. As a result, it is critical to maintain critical services while preventing GHG emission [2].

Avoid the consumption of gases hazardous to the ozone layer, due to their composition or production process. CFCs (chlorofluorocarbons), halogenated hydrocarbons, methyl bromide, and nitrous oxide are among the most harmful gases [3]. Therefore, refrigerant recovery machines are very important to reduce GHGs and become an essential in the heating, ventilation, and air conditioning industries. This is to comply with all legislations and regulations that have been established in an effort to reduce ozone depletion potential (ODP). Therefore, this study aim to maintain compliance with acts and regulations requirements under the Department of Environment Malaysia in handling solid and liquid fuels. Beside, to analyse the health effect and the environmental impact due to Greenhouse Gases (GHG) emission. Finally, to improve worker on proper recovery of refrigerant to reduce gas emission that impact environment and human health.

2. Materials and Methods

The research approach, research planning flow chart, data collecting, and practice application were all covered and explained in this chapter.

2.1 Materials

In prior to performing practice-based research, researcher identify and define the research topics to investigate, and then choose the appropriate research method. Workplace demands are taken into consideration when conducting this type of research. Underlying the thesis selection and decision making process will be an experiment-based and development-oriented approach.

A theoretical and a practical section are both included in the thesis. Theoretical section of the research discusses the research questions and background knowledge, as well as the practical section's findings and evaluations of those findings. The findings are compared to what is already known in the field. A development and implementation process for a refrigerant recovery machine is discussed in the practical section.

2.2 Methods

Primary data was collected in particular to address the problem in question and was conducted by decision maker, a marketing firm, a university or extension researcher, etc. [4]. Primary data can collect via several methods together with questionnaire, interview, observation and others. The key data for this study were acquired by questionnaire. Questionnaire be used which analyzes the importance of the each of the factor criteria and technicians' work behavior that caused impacts on environment and human.

Secondary data was facts that had already been collected and was generally available in published or electronic form. Secondary data has regularly been collected, analyzed, and organized with a specific purpose in mind, so it may had restrained applications to particular market research [4]. Secondary data

collected by using report, government policies, newspaper, journal and other publish document. Secondary data such as the journal, books and article are used in this research.

In this research, based on information obtained from human resource data, Edgenta Mediserve has a total of 13 employees for the HVAC Unit consisting of 11 technicians, 1 technical executive and 1 engineer. In addition, to support the operation of the HVAC Unit, Edgenta has a subcontractor namely Wadah Sejati Sdn. Bhd. which has a total of 7 contract technicians to support operations with the Edgenta HVAC Unit. The sample size is 20 respondents that technician in HVAC unit. For this research, the researcher had chosen to use purposive sampling which the technicians that involve in HVAC maintenance and operations. A purposive selection means the technique of choosing a number of groups of units in such a way that selected group's together yield as nearly as feasible the same average or proportion as the totality with respect of those characteristics which are already matter of statistical expertise [5].

In this research, 20 questionnaires were dispersed to the respondents in HVAC Unit. The 20 respondents had to answer and compared the importance of criteria of the cause of the refrigerant emission using likert scale followed by a series of five answer statements. A Likert scale is a rating scale used to assess attitudes, behaviours, and views. Respondents select the choice that aligns most closely with their feelings towards the statement or question. Usually, Likert scales have either five or seven alternatives. Response anchors refer to the options on each end of the table. The middle is typically a neutral place, with positive and negative alternatives on either side. Each item is assigned a score between 1 and 5 or 1 and 7. The format of a typical five-level Likert question, for example, could be; (1) Strongly disagree, (2) Disagree, (3) Neither agree nor disagree, (4) Agree, (5) Strongly agree. In addition to measuring the level of agreement or disagreement, Likert scales can also measure other spectrums, such as frequency, satisfaction, or importance [6].

2.3 Practice demonstration of refrigerant recovery machine

This method of observation is done through the involvement of the field of HVAC services regarding the study of refrigerant recovery process. Researcher will usually engage with the employees they want to study to clearly understand the refrigerant recovery method. For this project, the observation method used is to understand in more depth about the method of recovery process using recovery machine. Apart from that, it is also to ensure that each employee understanding and knowledge in use of refrigerant recovery machine and its methods are in accordance with the guidelines issued by the legislations, regulations and orders. Observation is made through practice application and demonstration from competent person. Research methods include observing the recovery process and applying practice to obtain data and also study about the process. The practical application will be done by competent and trained technicians to control the refrigerant recovery machine. This practice will also be shown to other technicians as training

3. Results and Discussion

In this result and discussion chapter presented analysed data collected from technicians that involve in handling of refrigerant recovery machine in maintaining HVAC unit. All the data have been collected from questionnaire then analysed to achieve the objective of the research. The analysis was conducted by using Google Form Questionnaire.

3.1 Results

The figures present an in-depth analysis of the findings from the survey and sheds light on the safety and health issues faced by the technicians. The insights obtained from this study will be instrumental in identifying areas of improvement in terms of safety and health practices to ensure a safer and healthier work environment for the technicians.

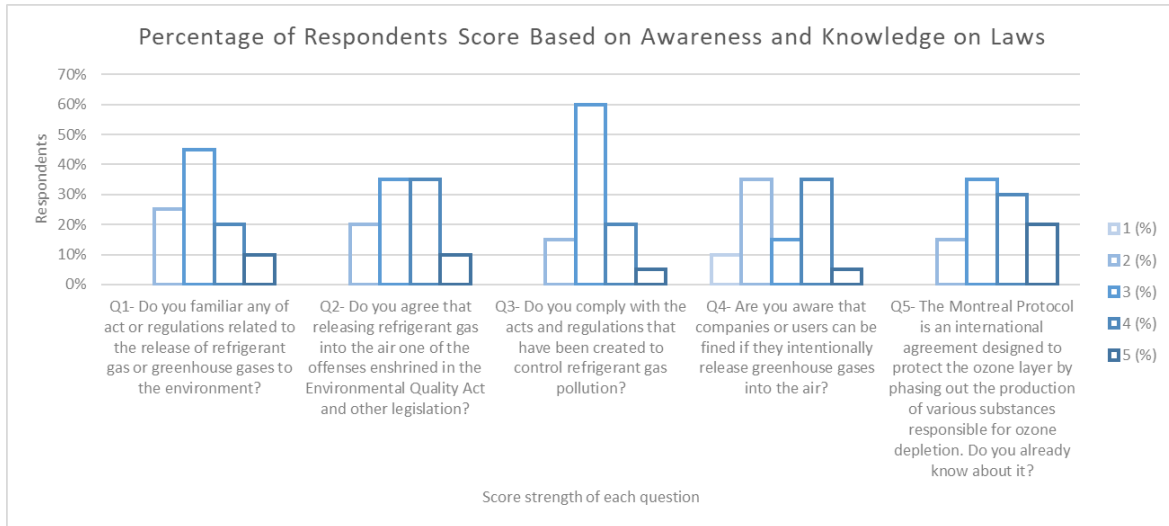


Figure 3.1: Percentage of Respondents Score Based on Awareness and Knowledge on Laws

Based on Figure 3.1, this shows that there Edgenta technicians still have poor knowledge about the act and regulations on refrigerant management. In addition, data shows technicians still disobeying the prohibitions in the act and regulations that have been created. There also got technicians who do not know that the refrigerants that have been handled all this time are polluting. The survey also found that some of Edgenta technicians still don't know about the Montreal Protocol where this is an effort at the international level to deal with the emission of greenhouse gases that have a big impact on the greenhouse effect.

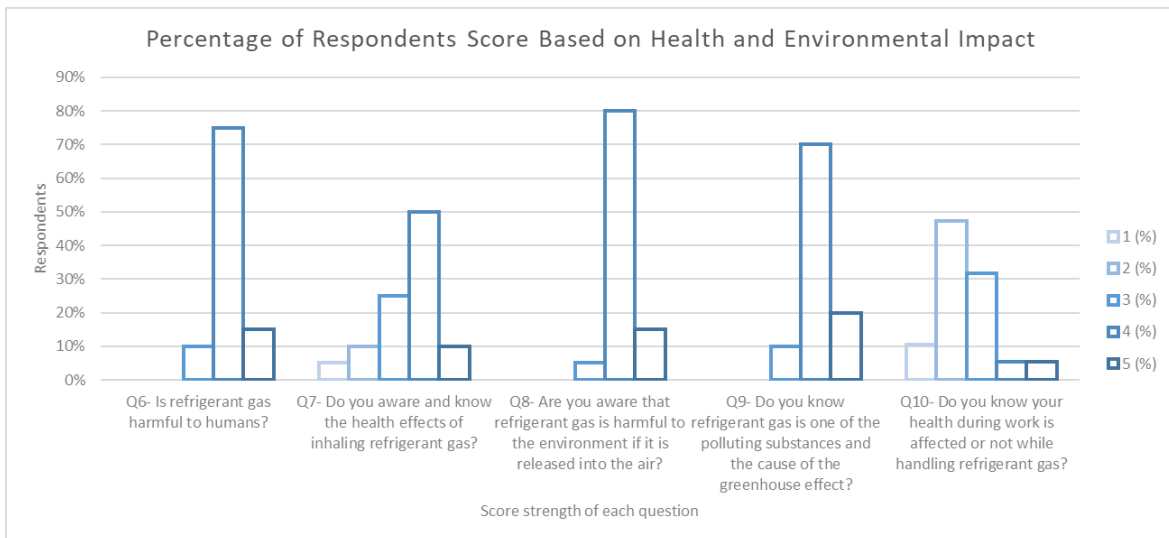


Figure 3.2: Percentage of Respondents Score Based on Health and Environmental Impact

Based on Figure 3.2, this shows that technicians are well aware of the refrigerant used and its dangers to humans. However, there are still two respondents who are not sure about the risks of dealing with refrigerants. In addition, data shows technicians are already aware of the dangers of refrigerants to health. However, there are still approximately 7 (35%) respondents who are still unsure about the dangers of refrigerant when inhaled. This data found that technicians are aware of the effect of refrigerant on the environment. However, Edgenta technicians are not aware that the refrigerant they have been using is dangerous to their health. Low emissions over a long period of time and high frequency can have long-term health effects.

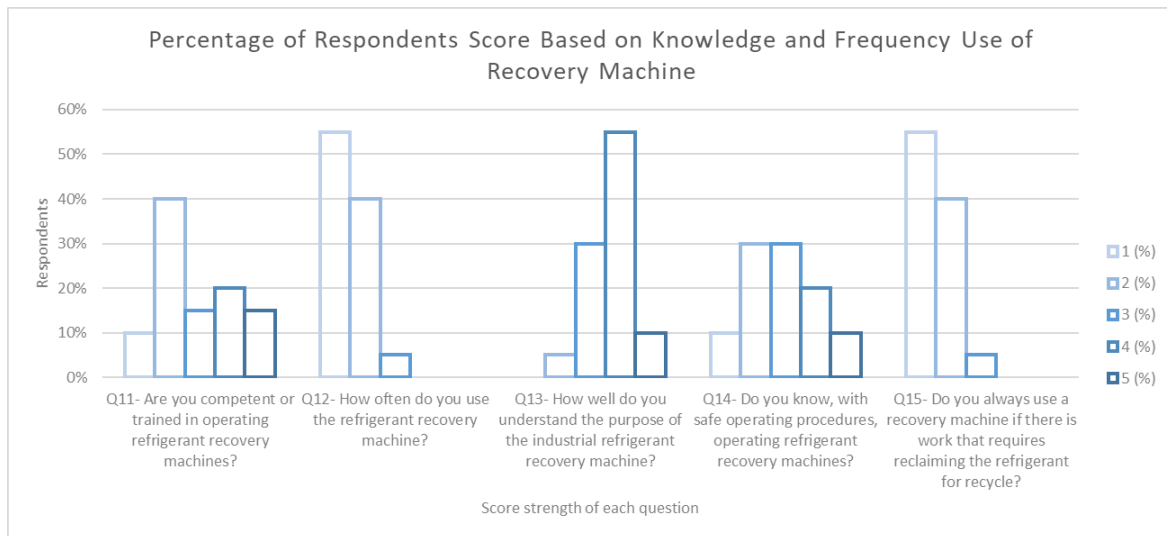


Figure 3.3: Percentage of Respondents Score Based on Knowledge and Frequency Use of Recovery Machine

Based on Figure 3.3, Edgenta technicians are not competent in operating the refrigerant recovery machine. This is one of the factors that this machine is rarely used in operations that involve work that requires refrigerant reclamation. This explains why technicians do not use the recovery machine, in fact some have never used it while working at HRPB. This shows that Edgenta technicians are not aware that releasing refrigerant into the air is illegal and inappropriate. Become a factor in the release of refrigerant when a large number of Edgenta technicians lack knowledge in recovering refrigerant using a recovery machine to be recycle refrigerant. It is an offense to release refrigerant, which is a dangerous gas, into the air.

3.2 Discussions

Based on the statistics and data obtained from the survey that has been conducted, the researcher found that there are lack of knowledge of act and regulations related to refrigerant released or emission. This shows insensitivity and awareness of the act and regulation that has been formed to control pollution caused by refrigerant emission. Knowledge of the law is vital for promoting legal culture. Every member of HVAC Unit technicians should have a fundamental understanding of the act and regulations. The law is commonly considered as a set of rules and regulations followed by technicians, i.e., the current rules in handling refrigerants. Thus, from the data survey that has been analyzed, Edgenta technicians need to be disclosed more about the acts and regulations that have been enacted to control greenhouse pollution, including The Montreal Protocol that has been enacted at the international level.

The researcher also found that there are lack of awareness on health hazard and impact on environment caused by refrigerant emission. The technicians need to have knowledge and awareness about the effect of refrigerant on their health and also the environment if it is released. This is important for technicians to know in order to control and follow the correct safe work methods to maintain health and the quality of the environment. However, with training and also promoting safety and health regarding the handling of refrigerants, we can increase the knowledge and awareness of technicians and immediately be able to improve performance in maintaining the quality of the environment. Thus, from the results of the survey data, it is suggested that the technicians undergo training and also implement more awareness about the refrigerants that are used on a daily basis.

Training for refrigerant management is important for technicians to know the importance of recovery and proper ways of recovering refrigerants. This training can train the technicians to operate the recovery machine immediately to improve the efficiency of the process to minimize the generation

of waste and the type of treatment that is possible to reduce the toxicity of the waste. Thus, what can be concluded from the survey, there are a large number of Edgenta technicians who still need to undergo training in handling refrigerants with safe operation procedures.

3.3 Safe operating procedures that should be followed when operating refrigerant recovery machines

The figure provides a comprehensive illustration of the safe operating procedures that should be followed when operating refrigerant recovery machines. It covers all the critical steps and procedures that must be followed to ensure safe and efficient operation of the machines.

Table 3.1: Safe operating procedure operating refrigerant recovery machine

Wear personal protective equipment:	When working with refrigerants, it is important to wear protective gear such as goggles, gloves, and a face mask to prevent exposure to hazardous substances.
Follow the manufacturer's instructions:	It is essential to read and adhere to the recovery machine's manufacturer's instructions. This will contribute to the machine's safe and proper operation.
Use the correct recovery cylinder:	Make sure to use the correct recovery cylinder for the type of refrigerant being recovered. Using the wrong cylinder could result in an explosion or other dangerous situation.
Follow proper charging procedures:	When charging a system with recovered refrigerant, make sure to follow proper charging procedures to avoid overcharging or undercharging the system.
Perform regular maintenance:	Regular maintenance of the recovery machine is important to ensure that it is operating safely and efficiently. This should include cleaning and replacing any worn or damaged parts.

Based on table 3.1, by following these safe operating procedures, technicians can ensure that refrigerant recovery machines are used safely and efficiently, protecting both the environment and human health.

3.4 Overall Evaluation

The study collected 20 google form questionnaires. Demographics, including age, gender, race, religion, and work experience, were examined in the first part. The second part comprised priority order of each primary criteria, weight of likert scale, and percentage of each refrigerant handling and management question among Edgenta Mediserve technicians.

The evaluation found Edgenta Mediserve technicians lacking in act and regulatory understanding. Many of these technicians are unaware of how regular refrigerant handling impacts health and the environment. According to further research, this is due to a lack of awareness and expertise in operating refrigerant recovery equipment. Researcher revealed that technicians are poorly trained in operating refrigerant recovery machine. Figure 3.4 shows the percentage of respondents score of each survey question.

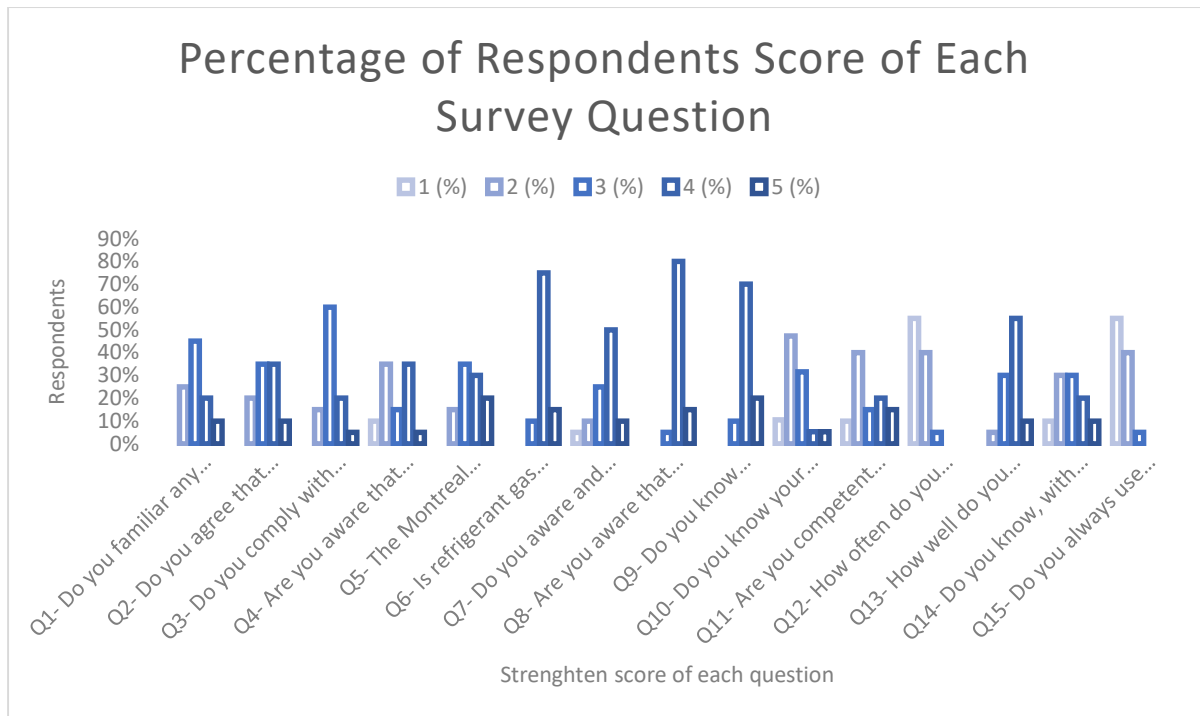


Figure 3.4: Percentage of Respondents Score of Each Survey Question

Based on figure 3.4, the questions that have been found are in the form of positive questions. The figure shows that respondents are more likely to choose answers rate 3 which is moderate and below 1 define as weakest value. As this survey was conducted to analyze knowledge and awareness in handling and managing refrigerants, the researcher found that the technicians were still weak in terms of knowledge and awareness about refrigerant management. As with question number 10, do the technicians know that refrigerant affects their health while working if inhaled, the percentage of respondents choosing rate 1-3 is higher, which is 17 people compared to rate 4 and 5. This shows the technicians' unawareness of the risks of working with refrigerant. In addition, question number 15, which is about the frequency of the technicians using the recovery machine when needed, the figure shows the tendency of technicians not to use the recovery machine when work involving refrigerant reclamation is required. Technicians keep disposing in the wrong way, which is to release into the air or dissolve in a bucket of water which is not a proper way and waste resource energy. This data leads to the conclusion that the researcher found that there are still weaknesses and lack of awareness in managing refrigerants as best as possible safely.

4. Conclusion

Based on the analysis that has been done as shown in Chapter 4, it is important for Edgenta Mediserve technicians to be knowledgeable about the laws and regulations related to refrigerant handling in order to protect the environment and ensure the safety of themselves and others. To improve the lack of awareness and knowledge about these laws and regulations, researchers can recommend providing training and education, developing resources and materials, encouraging communication and collaboration, and promoting the importance of compliance.

Similarly, it is important for technicians to understand the potential health and environmental impacts of refrigerants and to adopt responsible practices when handling these substances. To improve the lack of awareness and knowledge about these impacts, researchers can recommend providing training and education, developing resources and materials, encouraging communication and collaboration, and promoting the importance of responsible practices.

Finally, it is crucial for technicians to have knowledge and proficiency in operating refrigerant recovery machines in order to ensure safe and effective operation. To improve their knowledge and applicability in operating these machines, researchers can recommend providing training and education, developing resources and materials, encouraging hands-on practice, and promoting the importance of safe and responsible practices.

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