Indoor Environmental Quality Reflective Essay

Ozone Layer Depletion and Refrigerant Management

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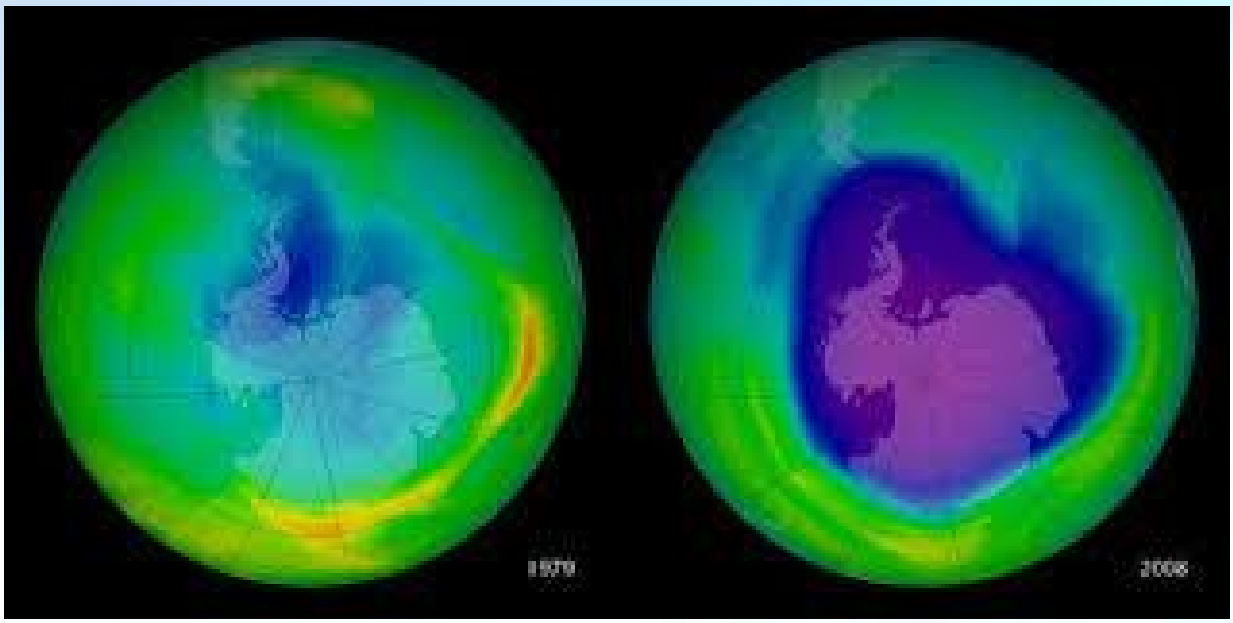

The above photo shows the 'Ozone hole' above the Antarctica region.

The ozone hole is increased from 0.1 km^2 in 1979 to 20.9 km^2 in 2016.

This is R22 refrigerant which is able to deplete ozone layer (ODP = 0.05). However, it is not entirely prohibited and still be used by old style air-conditioner nowadays.

In this module, we are focusing in indoor environment. No doubt, the outdoor factor can significantly affect the indoor parameters and they are going to affect each other due to their interaction. It is the reason why we should consider the environment issues as well. By this topic, the following passage is going to explain the ozone layer depletion by the aspect of definition, current situation and effect. Also, it will go on by how to improve refrigerant management and finally concluded by analyzing how the improved a building effects on ozone layer.

Ozone layer depletion

Ozone layer is a layer surrounding the atmosphere of the Earth by the component of ozone. Ozone is a reactive colorless gas, it is able to absorb harmful light from the Sun, such as Ultra violate B so it is essential to the life on the Earth (NASA, 2017). However, ozone(O3) is a very reactive chemical, it is able to be catalyzed into O2 by the association of 'CFCs' (Chemistry LibreTexts, 2014). CFCs are stable molecules mainly composed by chlorine, fluorine and bromine. Once it was emitted, they can easily flow to stratosphere (sky level of ozone layer exist) and act as the role of catalyst to deplete ozone layer. In the past few decades, CFCs has emitted massively by humans' activities such as using refrigerants, cleaning solvents and trafficking by airplane world widely (NOAA, 2017). The catalyst will not be consumed in the reaction process and remain at stratosphere for many years, catalyst more and more ozone molecules. Eventually, ozone hole above Antarctica was derived and discovered by scientists with the British Antarctic Survey in 1985 (Hunt, 2016). According to National Aeronautics and Space Administration's (NASA) definition, ozone hole is the region with the ozone value less than 220 Dobson units. It can be imagined as the concentration of ozone molecules because the low Dobson unit due to catalyzing reaction of ozone molecule. In addition, 220 Dobson units is chosen as the definition because the whole Earth used to be surrounded by the this number of units constantly, also, lower than the number 220 have not been found on the Earth ever except the observation over Antarctica after 1979 (NASA, 2017).

Due to the important role played by ozone layer, consequences of ozone layer depletion and the ozone hole has derived. The harmful effects are not only threatening human's health, but also interfere in ecosystem and economy.

For the effects on human health, it can cause permanent damage on skin and even cancer. Because of the decrease of protection from ozone layer, UV radiation, especially UV-B, will be massively absorbed by exposing skin. Over some years, collagen fiber and connective tissues of skin will be destroyed, skin will be inelastic and thickened permanently as the results. UV radiation can damage DNA materials as well, then cancer will be derived, which is hard to be cured and fatal. In 70s and 80s, skin cancer is not such prevalent, it usually occurs on occasionally exposed body part such as hands and face. However, nowadays cases are transferred to other

body part which is harder to be exposed. According to a UK founded ozone hole concern organization report, every 10% of global ozone loss can intensify the incidence of human suffer from skin cancer by 26%. Apparently, the increasing risk trend of suffering skin cancer is contributed by ozone layer depletion. For the current situation, Australia is a country near to the ozone hole, two third of its population suffer in a form of skin cancer. For a Northern Hemisphere country – America, skin cancer has been intensified by 20 times compared with the day before ozone hole discovery (Ozone-hole Organization UK, n.d.). On the other hand, high UV absorb of eyes can prompt high risk of suffering from cataract. A process called 'Oxidative stress' will take part when the harmful ray of the Sun supplying to eyes. In short, this process will turn the color of our lens from colorless to milky and cataract was suffered (NIH, 2014).

For the ecosystem, ozone layer depletion is certainly being harmful to wide range of organisms. The most related impact to human is the decrease of crops production, such as wheat, rice and corn. They will be vulnerable under high UV ray, the growth rate and production decreased as the results. Data from a research in 1998 stated that, an experiment simulated 20% of ozone layer depletion by addition of UVB radiation, crops are averagely 10% smaller (M. Tevini, 1991). Global agriculture issue can contribute to a large scale of starvation.

For economic impacts, materials commonly used by humans will be degraded by high UV radiation. In fact, the impurities in plastic is likely to accept UV radiation then cause degradation. Wood, plastic, rubber etc. are common construction materials of buildings and facilities, replace and protect those materials cost much and being a heavy load on our economics. For example, the outdoor tubes have to be coated by FEP (Fluorinated Ethylene Propylene) as its property allow it to defense UVB (Cole-Parmer, 2017).

Refrigerant Management

As the above explanation, it is certain that ozone layer depletion is due to refrigerant usage. In this time, refrigerant management is a crucial strategy to minimize the environmental impact. In the term of refrigerant management, it can be divided into different management strategies such as refrigerant selection and refrigerant leakage prevention.

In fact, not all refrigerant has a potential of depleting ozone layer. If the refrigerant molecule has no CFCs content, then it is disable to catalyst ozone molecules. A scientific tool for assessing the ability of depleting ozone layer is called ODP (Ozone Depletion Potential). The maximum value of ODP is 1, as long as the ODP value of a refrigerant is larger than zero, it represents there is a potential of depleting ozone layer (The Engineering Tool Box, n.d.). For example, the ODP value of refrigerant CFC 12 is 1, that means it has a strong ability to catalyst ozone molecule. However, it is widely used after its invention in 1930s. Until 1970s, its impact on

ozone layer was discovered and gradually prohibited. In 2010, global production of CFC-12 stopped eventually (The Ozone Hole Inc., n.d.). The boost of stop using those harmful refrigerant is the invention of 0 ODP refrigerant. For examples, HFC and HFO series are the types of refrigerant never catalyst ozone molecules. Indeed, there are some drawback of using these refrigerants. HFC has a higher GWP (Global Warming Potential) value, average 3600 GWP in the HFC series. Compared with a non-zero ODP series, HCFC series refrigerants, most of their GWP values are lower than 2000. Especially HCFC123, its GWP value is just 77 (Linde, n.d.). In order to protect our ozone layer, select 0 ODP refrigerant is a wiser determination. If the building is operating with ODP valued refrigerant, it is going to impact on ozone layers and damage our health eventually.

We have no means to give up all ODP valued refrigerants globally, but we can prevent its leakage from coil. A leakage of refrigerant may lead the refrigerant violate to atmosphere and damage ozone layer. According to a report done by UK organization, air-conditioning refrigerant leakage rate average is 10% annually (IOR, 2010). Monitoring refrigerant volume, refrigerant leakage warning system and joint of refrigerant pipes can be the consideration of leakage control. Many products of technology co. can be brought easily to detect refrigerant leakage. Let us see an example from a technology co. called EMERSON, 'Refrigerants Leakage Detection System' (RLDS) is one of its product. RLDS is able to monitor every CFC, HCFC and HFC refrigerants, which is able to fit many MVAC system. Meanwhile, it can be fitted with up to 16 zones in a building and release signal to controller immediately when leakage happens. It enables users to know the latest situation of the MVAC system. When the controller receives the leakage warning, they can call technician immediately and minimize leaked refrigerant damage ozone layer (monitor system ref.). In the meantime, refrigerant manager should collect the data and analyst how to fix the problem. From the previously report, it said that 96% of refrigerant leakage occur at the joint part, selection of joint can help preventing refrigerant leakage. In the report, it stated that flare joint has the highest probability occur leakage, the second is shaft seal then we should avoid using those joint. If it is unavoidable, much attention have to be paid on warning so as to relieve the leakage condition.

Building Impact on Ozone Layer

Air-conditioning system is a must-installed facility in nowadays building. Refrigerants become more and more important as VRV system become popular. Leakage of refrigerant can damage ozone layer if the refrigerant has positive ODP value, then a series of consequences will be derived such as skin cancer and cataract on human. Nowadays, refrigerants used in building is intended be 0 ODP value, meanwhile, potential ozone depleting refrigerant's market scale is being smaller. It is due to the risk assessment report done by international concern organization, such as 'WMO report of International Ozone Trends Panel' in 1988 and the

'IPCC/TEAP Special Report on Safeguarding the Ozone Layer and the Global Climate System' in 2005. After the propagations and actions, the issue trend shows it is relieving. From the ozone hole watch provided from NASA, the ozone hole size is decreasing gradually, it is expected that the ozone hole will vanish in 2070s.

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