Low-carbon and low-ozone depletion utilization on the environmental-friendly air conditioning

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Abstract: Where we are in is the environmental era of the earth. People are paying attention to human existence and sustainable development universally. So the duty of air conditionings is not only resting on the control of indoor environment, but also regarding the efficient energy utilization of air conditionings and the effect on global environment. In this paper, the emission of greenhouse gases, ozonosphere breakage, low carbon and low ozone depletion of the environmental-friendly air conditioning are expounded.

Key words: greenhouse gas; global warming; ozonosphere breakage; environmental-friendly air conditioning

The energy consumption is expanding for man creates more abundant living condition. Along with the improvement of the standard of living all over the world, the balance of the limited energy supply-need has been broken resulting in rapid markup of international crude oil recently.

Some scholars brought forward the so-called “three must” judgments in order to making all men can live the equal living with the developed countries. The most energy we are using is from fossil fuel, and the rising of energy consumption means the enlargement of exhaust gases emissions.

If we let alone the prodigal social continue pursuing the policies of mass-produce, mass-consume and mass-disuse, the earth environment will be destroyed post. The heritage of next generation will be negative. Especially the atmosphere concentration of carbon oxide which is global warming gene, is exceeding 340×10^{-6} recently, and that was 280×10^{-6} before industrial revolution (A.D.1800). So the research and development of air conditioning should be with a view to environmental protection and sustainable development.

1. Kinds of greenhouse gases and effect on global warming

The IPPC (Intergovernmental Panel on Climate Change) analyzed the greenhouse gases (see Tab.1). It is showed the proportion of carbon oxide, methane, Freon, nitrous oxide and other greenhouse gases affect global warming.

Tab.1 Effect proportion on global warming of greenhouse gases

Greenhouse gas	CO2	CH4	Freon	N2O	Other
Effect proportion	63.7%	19.2%	10.2%	5.7%	1.2%

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In these greenhouse gases, CO2 gains 2/3. Thus it can be seen the way of reduction of CO2 emission is effective to restrain global warming.

The second main factor is methane. Methane sealed in the permafrost formerly has thrown off into the atmosphere for global warming makes it tend to dissolution and further global warming which forms a vicious circle again and again. Moreover, methane can

produce naturally else from the lake and the paddy field.

Freon in the air conditioning not only destroy ozonosphere, but also becomes the main factor of global warming if let it into the atmosphere.

2. Why earth produces greenhouse effect?

About 70% of the energy from the sun is absorbed by the atmosphere and the earth's surface. The heat emitted from the earth surface is absorbed by the greenhouse gases of CO2 and CH4 etc. which are merely 0.03% of the atmosphere. So the average air temperature of earth can keep about 15℃ fitting life-form existence.

If the content of the greenhouse gases increases, the earth's surface will form adiabatic effect consequently accelerating global warming.

3. What is ozonosphere breakage?

Freon is a safe, in-noxious and non-combustible refrigerant and its chemical and thermal stabilities are very high. But it was used for vesicant and sprayers resulting in the enlargement of Freon emissions into the atmosphere and ozonosphere breakage. "Vienna Convention for the Protection of the Ozone Layer" was passed in 1985.

Ozone is provided with sterilization, bleaching and harm to creature. It is in the earth's stratosphere to bar the solar harmful ultraviolet radiation and protect creature.

Freon gas discharged to the atmosphere is very stable with chemical performance in the earth's troposphere. When it comes to the stratosphere, it is decompounded and gives out chlorine atoms to destroy ozone due to the intense irradiation of solar ultraviolet radiation. This chain reaction makes ozone decreasing.

In case ozone layer is destroyed, the ultraviolet radiation will arrives to the earth straightway and endanger the existence of creature.

4. Effort for protection of ozone layer

"Montreal Protocol" concerning ozone depletion substances was passed by 171 countries and European Economic Community at Sep., 1987. The given Freon (CFC) of high ozone depletion potential (ODP) has been banned in 1996.

The substitute Freon (HCFC) of low ODP has also been forbidden production in 2005.

In the developing countries, the production restriction of various kinds of Freon has become effective in 2005 too.

The kinds of refrigerant and production restriction are shown at Tab.2.

Tab.2 Kinds of refrigerant and production restriction

Kinds of refrigerant	Main demonstrations	Production restriction
CFC	R11 (turbine freezer); R22 (automobile air-conditioning); R502 (cryogenic freezer)	☆banned in 1996 ★staggered restrained output after 2005
HCFC	R22 (PA, RA); R123 (turbine freezer)	☆staggered restrained output after 2004 ★staggered restrained output after 2016
HFC	R134a (water chiller); R407C; R410A (PA, RA)	

Note: ☆restriction to the developed countries; ★restriction to the developing countries; PA-packaging air-conditioning; RA-residential air-conditionin

The comparisons of ODP and GWP (Global Warming Potential) on various refrigerants are given at Tab.3.

Tab.3 Comparisons of ODP and GWP on various refrigerants

Kinds of refrigerant	Representative demonstration	ODP	GWP
CFC	R12	1.000	8100
HCFC	R22	0.055	1500
HFC	R407C	0	1560

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It's obvious to restrict CFC production ahead for its high ODP and GWP. And HFC is forbidden to emit to the atmosphere although zero ODP but higher GWP. The manufactures should bear the responsibilities of callback, regeneration, recycle and analysis.

5. Environmental-friendly air conditioning

5.1. Representative air conditioning in Japan

In today of globalization, the corporations which are tenants living in buildings present different working ways.

In Japan, besides on duty time, the air conditionings of whole buildings do not operate basically.

The energy saving measures on the air conditionings of large energy consumption were put forward after the first oil crisis attack to Japan in 1973. The following is recapitulative:

①The air conditioning is just operating in the required time and space (avoid meaningless energy consumption);

② Reduce the feeding drive of heat source (the proportion of the feeding drive is very high in air conditionings);

③ The independent temperature control should be implemented (prevent super-cooling or super-heating).

That's to say, the intention of energy saving can be achieved if the shortcomings of air conditionings are conquered.

After the second oil crisis, the VAV clone air conditioning system was developed for large-scale and medium-scale buildings. This system has the characteristics of frequency conversion compressor, independent and separated indoor units, longest cooling medium tubing and compact control wirings.

The small split air condition of frequency conversion is applied widely at stores and small-scale office buildings as the power consumption of the frequency conversion air condition is below 70% of the frequency changeless one.

5.2. Types of heat source and comparison of CO2 emissions on air conditionings

Energy is needed for the operation of air conditionings. As far as the heat sources of air conditionings are concerned, they are comprised the Freon refrigerating machine using electricity and the absorption refrigerator using gas and fuel on the whole. The two are compared through primary energy conversion at Tab.4. The results show the primary energy consumption of electricity type is lesser, as well as the CO2 emission.

Tab.4 Types of heat source and comparison of CO2 emissions on air conditionings

Types of heat source	Rated COP	Efficiency of generating electricity	Transmitting electricity loss	General efficiency	CO2 emission
Absorption	1.0	-	-	1.0	Benchmark
Electricity	3.8	40%	2%	1.44	69.5%

COP expresses refrigerating output/energy consumption. The higher of its value explains the high performance.

In the above rated COP, the COP of all-year operation is higher for the excellent partial load of frequency conversion machines, and the CO2 emission is also lower.

5.3. Guess of CO2 emissions from the service life period of air conditionings

The CO2 emissions in the service life period of air conditionings from manufacture to service end are calculated at Tab.5.

Tab.5 Guess of CO2 emissions from the service life period of air conditionings

Trash and recycle process	Making process of flan and parts	Making process of products	Circulation process	Service process
2.8%	3.5%	0.6%	0.2%	93%

The required energy makeup proportion of service process is very high 93%. It is obvious that the air conditioning of high COP performance is the best choice to restrain global warming.

5.4. Energy consumption increase of fossil fuel also destroy otherwise environment

Burning fossil fuel is able to let exhaust gas which is global warming gas, sulfur dioxide and nitrogen dioxide (except natural gas).

Acid rain can be formed down to ground bringing a bad influence to plant after the diffusion of sulfur dioxide in the air, and blocking plant to make photosynthesis with CO2. Nitrogen dioxide can pose the chemical soot does harm to the health of human and animal.

In a word, we must control the consumption of fossil fuel more.

6. Conclusions

The developed countries are taking up with the direction of environment accommodation for ozonosphere breakage and global warming. For example, the USA as the most energy consumption country in the world has been changing HCFC to HFC gradually in air conditionings. The environmental-friendly air conditioning should be developed based on the aim of harmonious sustainable development of human and global environment.

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