Journal of Basic and Applied Engineering Research
p-ISSN: 2350-0077; e-ISSN: 2350-0255; Volume 2, Issue 23; October-December, 2015, pp. 2030-2033

http://www.krishisanskriti.org/Publication.html

# Pollution Scenario and Carbon Capture Technologies

**Ashwini Dinodia**

*Department of Pharmaceutical Education and Research Bhagat Phool Singh Mahila Vishwavidyalaya, Khanpur Kalan Sonipat-131305 (HR)*

**Abstract—***Now a day's global warming creating a big problem all over the world.Today the pollution is increasing day by day specially the air and water pollution is increasing and is creating health related problems specially in children and old persons and this is clearly visible in the regions of Delhi and is increasing alarmingly to a big extent.for this we can use the carbendioxide techniques by which we can trap these increased level of co2 and further stored and transported so that the residents of delhi can be relieved for a big period of time.*

**Keywords***: Air pollution, Water pollution, Carbon-di-oxide caprture technologies*

## 1. INTRODUCTION

Pollution is the major cause for depleting and degradation of health in urban areas. It can be defined as the contamination of the environment with materials which can cause interference human health and functioning of ecosystem. There are various types of pollution like air pollution, noise pollution, sound pollution, water pollution and land pollution. But the major pollution in Delhi is air pollution now these days and is increasing at an exponentially which is creating various health problems for Delhi residents people now a days. It is very difficult to control any type of pollution but proper measures are taken by the Delhi Govt to tackle the pollution and the water and air pollution is one the most serious pollution which is faced by Delhi people.

## 2. PRESENT SITUATION OF POLLUTION IN DELHI

Delhi (National Capital Territory of Delhi) which is controlled by centre and state government.Acc to 2011 censes it accommodates more than 167 lakh people (1). A study was made by World Bank Development research group in 1991-94 on the effects of air pollution (2). In study it was found that the average total suspended particulate (TSP) level in Delhi was nearly five times in standard accordance by WHO. It was also found that the TSP level was more than 95% in Delhi at all time in 24hrs by standard accordance with WHO (3).at present the mortality due to air pollution is increasing at an alarming rate specially in case of young once and the old age persons rather than the trauma death. Also due to increase in the particulate matter in environment the death toll is increasing in comparison with the non trauma death. It is estimated that more than 4000 metric tones of pollutants are emitted and still it is increasing everyday in Delhi which contributes nearly 70% of total pollution in Delhi which is followed by coal based thermal plants which contributes approx 15% of the total pollution in Delhi .Now a days there is increase of small scale industries in Delhi and hence more and more air pollution acc to the recent survey (4).

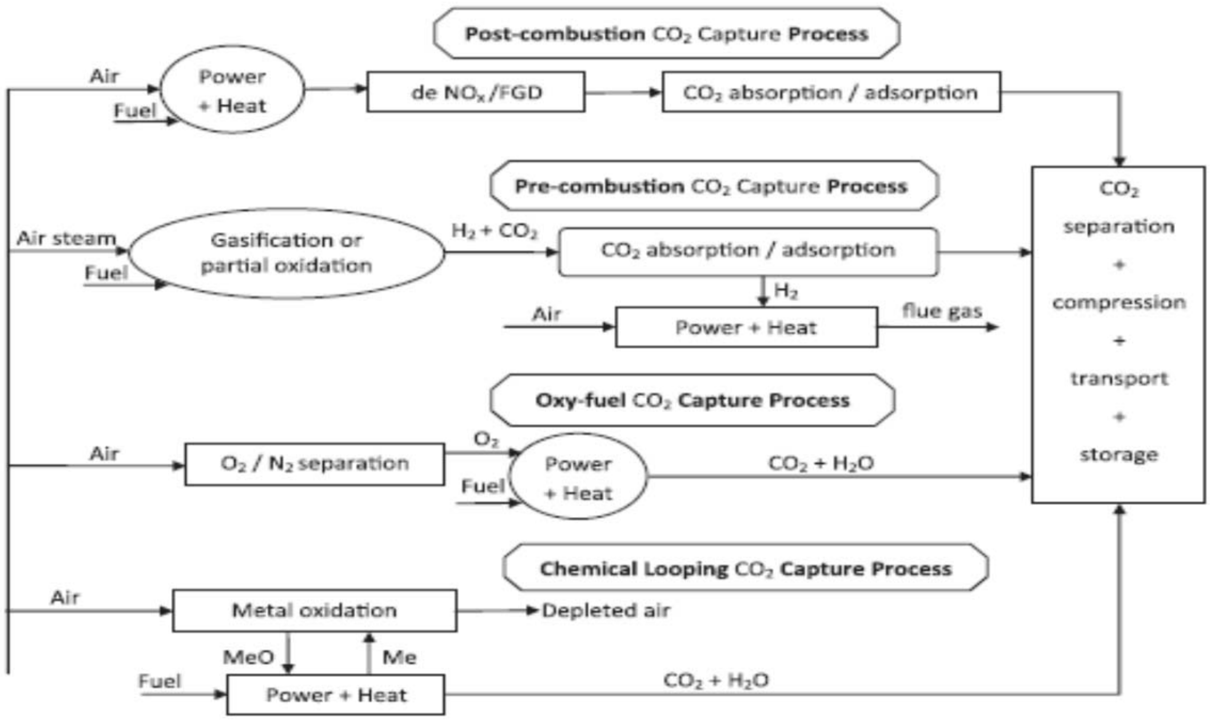
## 3. CARBON-DI-OXIDE CAPTURE TECHNOLOGIES

$CO_2$ is formed due to combustion of the substance which is harmful to the living beings. There are various technologies in world by which we can decrease the CO2 hence their by redusing the carbon foot print but these technologies are very costly and 70-80% of the total cost of CCS system includes capture, transport and storage(5). There are three main CO2 capture systems with different combustion process named as post combustion, pre combustion and oxyfuel combustion

a) **Post combustion**:-In this process there is removal of CO2from fuel gas after the combustion. They have been preferred for retrofitting existing power plants. It is best for small scale with CO2 and is recovered at 800t/day(6) and the major disadvantage of this process is high parasitic load because the combustion level ofCO2 in fuel gas is 7-14% for coal fired and 4% for gas fired hence the cost for storage and transport is increased(7-9).

**b)** **Precombustion**:- In this process the fuel is pretreated before combustion .for coal it involves gastrification process which is conducted in gasrifier under low oxygen level forming syngas which is a combination of H2 and CO and is free from other pollutant gases. This syngas then undergo watergas shift reaction with steam forming more H2 while CO is converted to CO2. When the CO2 concentration is more than 20% in the h2/co2 gas then the CO2 gas easily get extracted out (9).

**c)** **Oxyfuel combustion**:- In this combustion oxygen is used for combustion instead of air which reduces the amount of nitrogen present in the exhaust gas which further affects the separation process(10).Due to use of pure oxygen the major composition of the fuel gas is CO2,water particulates and SO2.particulates and SO2 can be removed by electrostatic precipitator and fuel gas can be removed by desulphurization method and the remaining gas containing CO2 can be compressed , transported and stored.(9)




**CO2 capture technologies**

| Strategy | Application area/sector | Advantages | Limitations |
|---|---|---|---|
| Enhance energy efficiency and energy conservation | Applied mainly in commercial and industrial buildings. | Energy saving from 10% to 20% easily achievable. | May involve extensive capital investment for installation of energy saving device. |
| Increase usage of clean fuels | Substitution of coal by natural gas for power generation. | Natural gas emits 40–50% less $CO_2$ than coal due to its lower carbon content and higher combustion efficiency; cleaner exhaust gas (lower particulates and sulfur dioxide emissions). | Higher fuel cost for conventional natural gas. Comparable cost for shale gas. |
| Adopt clean coal technologies | Integrated gasification combined cycle (IGCC), pressurized fluidized bed combustor (PFBC) etc. to replace conventional combustion. | Allow the use of coal with lower emissions of air pollutants. | Significant investment needed to roll out technologies widely. |
| Use of renewable energy | Hydro, solar (thermal), wind power, and biofuels highly developed. | Use of local natural resources; no or low greenhouse and toxic gas emissions. | Applicability may depend on local resources availability and cost. Power from solar, wind, marine etc. are intermittent and associated technologies are not mature; most current renewable energies are more costly than conventional energy. |
| Development of nuclear power | Nuclear fission adopted mainly in US, France, Japan, Russia and China. Nuclear fusion still in research and development phase. | No air pollutant and greenhouse gas emissions. | Usage is controversial; development of world's nuclear power is hindered due to the Fukushima Nuclear Accident in 2011, e.g. Germany will phase out all its nuclear power by 2022. |
| Afforestation and reforestation | Applicable to all countries. | Simple approach to create natural and sustainable $CO_2$ sinks. | Restricts/prevents land use for other applications. |
| Carbon capture and storage | Applicable to large $CO_2$ point emission sources. | It can reduce vast amount of $CO_2$ with capture efficiency > 80%. | CCS full chain technologies not proven at full commercial scale. |

**Cost comparison for different capture process(11).cost include co2 compression to 110 barr but excluding storage and transportation costs**

| Fuel type | Parameter | Capture technology | | | |
|---|---|---|---|---|---|
| | | No capture | Post-combustion | Pre-combustion | Oxy-fuel |
| Coal-fired | Thermal efficiency (% LHV) | 44.0 | 34.8 | 31.5 | 35.4 |
| | Capital cost ($/kW) | 1410 | 1980 | 1820 | 2210 |
| | Electricity cost (c/kWh) | 5.4 | 7.5 | 6.9 | 7.8 |
| | Cost of $CO_2$ avoided ($/t $CO_2$) | – | 34 | 23 | 36 |
| Gas-fired | Thermal efficiency (% LHV) | 55.6 | 47.4 | 41.5 | 44.7 |
| | Capital cost ($/kW) | 500 | 870 | 1180 | 1530 |
| | Electricity cost (c/kWh) | 6.2 | 8.0 | 9.7 | 10.0 |
| | Cost of $CO_2$ avoided ($/t $CO_2$) | – | 58 | 112 | 102 |

**CO2 separation technologies**

These are technologies by which we can separate CO2 from the fuel gas before the transportation. There are various types of technologies by which we can separate the CO2 from fuel gas like dry regenerable solvents, membranes, cryogenics, pressure and other advanced technologies are as follows

1. **Adsorption**:-In this process liquid adsorbant is used and solid adsorbant is used to bind CO2 on its surface. High regeneration ability, high selectivity and large surface area are the criteria for the sorbent selection. Sorbents like molecular sieve, activated carbon, zeolites, calcium oxides and hydrotalcites etc. By swinging the pressure (PSA) or temperature of the system (TSA) containing the CO2 saturated sorbent adsorbed CO2 can be recovered.PSA is done commercial level because t is having efficiency of more than 80% and this technology deals in recovery of CO2 from power plants (12-13). In TSA the adsorbed CO2 can be extracted by increasing the temperature of system by using hot air or stem injection. Its purity of CO2 is more than PSA but the regeneration time is longer than PSA. In case of PSA it is done at high pressure so that the CO2 is release and can be stored (14).

2. **Absorption** :- In this liquid sorbent is used to separate CO2 from fuel gas and these sorbent can be regenerated by heat or depressurization and is the most mature method for CO2 separation(15). Different types of sorbents used in absorption are monoethanolamine(MEA), diethanolamine(DEA) and potassium carbonate(16) and it was found that MEA was found to be more efficient for CO2 absorption(17).

3. **Chemical looping combustion**:-In this metal oxide is used an oxygen carrier instead of pure oxygen instead of pure oxygen. In this process the metal oxide is redused to metalwhilethe fuel is oxidized to CO2 and water. water which is byproduct in this process is removed by condensation while co2 can be obtained without consumption of energy.different metal oxides used in this process are Fe2O3, NiO, CuOandMn2O3 etc(18).

## REFERENCES

[1] Available from: http://www.censusindia.gov.in/2011-provresults/data_files/delhi/0_PDFC-Paper-1-2011%20NCT%20of%20 Delhi_9.pdf.

[2] The Health Effects of Air Pollution in Delhi, India, Maureen L.Cropper, Nathalie B. Simon, Anna Alberini, P. K. Sharma, The World Bank Development Research Group, December 1997. Available from: http://www.airimpacts.org/documents/local/WB_WPS1860_Delhi_AQ.pdf

[3] White Paper on Pollution in Delhi with an Action Plan, Ministry of Environment & Forests, Government Of India, 1997. Available from: http://envfor.nic.in/divisions/cpoll/delpolln.html.

[4] WHO Air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulfur dioxide, Global update 2005, Summary of risk assessment. Available from: http://whqlibdoc.who.int/hq/2006/WHO_SDE_PHE_OEH_06.02_eng.pdf

[5] Blomen E,HendriksC,NeeleF. Capture technologies: improvements and promising developments. Energy Procedia 2009;1: 1505–12

[6] WallTF.Combustion processes for carbon capture .In:Proceedings of the combustion institute, Vol.31;2007.p.31–34

[7] de VisserE,HendricksC, BarrioM, MolnvikMJ, deKoeijerG, LiljemarkS, et al .DynamicsCO2 quality recommendations. Int J Greenh Gas Control 2008;2:478–84.

[8] ICF. Developing a pipeline infrastructure for CO2 capture and storage; issues and challenges. Technical report prepared for INGAAFoundation.2009 (106 pp.)

[9] OlajireAA.CO2 capture and separation technologies for end-of-pipe application – a review .Energy 2010; 35: 2610–28

[10] Buhre BJP, ElliottLK, ShengCD, GuptaRP, WallTF. Oxy-fuelcombustion technology forcoal-fired power generation. Prog Energy Combust Sci 2005;31:283–307

[11] InternationalEnergyAgencyReport.CO2 capture as a factor in powerstation investmentdecisions.ReportNo.2006/8,May;2006.

[12] TakamuraY, NaritaS, AokiJ, UchidaS. Applicationof high-PSA process for improvement of CO2 recovery system. Can J Chem Eng2001; 79:812–6.

[13] McKee B. Solutions for the 21st Century: zero emissions technology for fossil fuels. France: IEA, Com. Energy Research and Technology. OECD/IEA; 2002.

[14] Clausse M, Merel J, MeunierF. Numerical parametric study on CO2 capture by in direct thermals wing adsorption. Int J Greenh Gas Control 2011;5:1206–13

[15] Bhown AS, FreemanBC. Analysis and status of post-combustion carbon di oxide capture technologies. Environ Sci Technol 2011;45: 8624–32.

[16] Hendriks C. Energy conversion: CO2 removal from coal-fired powerplant. Netherlands:Kluwer Academic Publishers;1995.

[17] Aaron D, Tsouris C. Separation of CO2 from flue gas: A review. Sep Sci Technol 2005;40: 321–48

[18] Adánez J, deDiegoLF, García-LabianoF, GayánP, AbadA, Palacios J M. Selection of oxygen carriers for chemical-looping combustion. Energy Fuels 2004;18:371–7.