
Cement construction: Prospective and Realization

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ABSTRACT

In this article, three approaches of CO₂ diminution including energy saving, carbon severance, and storage as well as exploit substitute materials in detail have been evaluated. In case of power economy move toward, uneven to more ordered method shows the best outcome because potentially mitigates almost 20% of CO₂ emissions in the process. Carbon capture and storage (CCS) is also considered as an efficient way to avoid release of CO₂. However economical and technical challenges still play as significant obstruction besides implementing such development in cement plant. As far as substitute materials are the case, exploit waste-derived fuel (WDF) and manufacturing by-products as a substitute of predictable fuels and materials result in important emission improvement.

Key Words: *Substitute materials, cement plant, CO₂ emissions, CO₂ improvement, global warming.*

1.1 INTRODUCTION

Carbon dioxide is the most significant and plentiful gas among all GHGs which have the uppermost donation in global warming occurrence. Thus, finding promising approach to alleviate CO₂ emissions is the precedence of studies to subside the threat of climate change. In subsequent, emissions in industrial sector are explained while a complete explanation of the sources of carbon dioxide emissions in cement method is included. In conclusion, technical approaches and studies toward production improvement in cement plant.

1.2 MANUFACTURING CO₂ PRODUCTION

Almost 61% of global CO₂ productions are provoked by industrial activities showing the important collision of such processes on weather change. Though the urgent request for energy and production diminution is internationally admitted, global industrial GHGs emissions are being quickly increased; it is anticipated to be 14 Gt CO₂ by 2030. This production is frequently due to combusting enormous capacity of carbon thorough fossil fuels to produce required power in the method. In accumulation, some industrial processes have reactions which chemically change raw materials to waste gases such as CO₂. The list of such processes can be found in Draft record of U.S. Considering USA as the second largest carbon producer country, three major emitting manufacturing construction are steel and iron construction, cement construction, and ammonia construction, with the emissions of 42.6 Tg CO₂ Eq, 29.4 Tg CO₂ Eq and 11.8 Tg CO₂ Eq correspondingly.

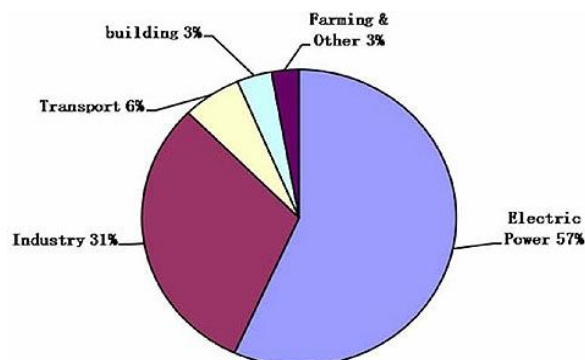


Fig.1 Manufacturing Co2 production

1.3 BASIS OF CO₂ CREATION IN CEMENT METHOD

Cement manufacturing is measured to be one of the highest carbon dioxide emitting industries in the world. The process emits around 900 kg of CO₂ for every ton of cement produced which constitutes roughly 5-7% of the global anthropogenic carbon dioxide emission. During the cement manufacture process, CO₂ is emitted by four dissimilar sources. Ignition of fossil fuel in pyro-processing unit produces 40% of total emissions, while another 10% is in result of raw materials transportation and electricity generating inspired by electrical motors and facilities. The rest which contributes the uppermost amount of emissions (almost 50%) is released during disintegration of CaCO₃ and MgCO₃ to produce CaO and MgO as the elementary chemical reactions in the process. in addition; there are many major and minor technological and organization problems which can authority plant presentation requiring supplementary fuel and electricity expenditure. These additional consumptions can lead to important thermal waste and, in importance, significant extra CO₂ emissions.

1.4 PROPOSED SYSTEM

In common three major planned approaches toward carbon enhancement have been typically studied during recent decades including:

- Approach 1: coal and power saving
- Approach 2: carbon incarceration and storage
- Approach 3: utilizing alternative materials

A. Approach 1: coal and power saving

Diminution in fuel expenditure especially remnant fuels as the most air polluting sources can significantly supply in abating global production of pollutant gases, greenhouse gases, and solid atom. Coal and power saving is also an efficient approach to slow down reduction of fossil fuels and letting the next generations to utilize such expensive resources as we do. This target has been achieved by dissimilar approach including method alteration, process combination, protection, lagging, power recovery, and so on.

1) Employing more energy efficient processes

While in a dry method, the raw meal is initially pre-dried and even pre-calcinated before incoming the rotating kiln, in the case of a wet method, raw meal is fed with high wetness satisfied honestly into a long rotary kiln. Consequently, part of total energy is inspired to disperse the wetness contented and to arrange equipment for calcinations reactions. That is the reason of extraordinary dissimilarity between power expenditure in these two processes. It is possible to save up to 50% of required force and to decrease 20% of CO₂ emissions by shifting to dry process with calciner from wet development.

2) Diminution of thermal heat losses in pyro-processing unit

In cement plant, 90% of total input power is inspired in the pyro-processing unit including pre-heater tower, calciner, kiln, and coolers. Energy is wasted in preheated tower during pipes, cyclones' shell, and leaking air. Obvious quantity of thermal power is also lost in calciner and the kiln during shield, exterior and leakages. In addition to heat losses in heating part, heat is also wasted in cooling part (air coolers). These fatalities can be due to leaking air as well as coolers' surface. In common, heat losses in pyro-processing unit can lead to wasting up to 20% of initial power, and it results in the release of 8% extra CO₂ from cement plant.

In case of losses during shield and surface, secondary shell as well as insulation layers have been applied. While, in case of air leakages, proper sealing methods and regulars monitoring and preservation have been proposed and implemented. These approaches have considerably reduced energy losses in the process.

3) Energy recovery from exhaust streams

Other remarkable sources of thermal heat losses in pyro-processing unit are flue gas and hot air streams. To improve and reclaim these sources of thermal power which waste up to 35% of total power, dissimilar technologies can be implemented depending on the volume and temperature stage of drain streams as well as position and the want of the process. In some works waste, heat recovery systems have been proposed to generate electrical energy from these two streams. In the other cases, drain streams have been used to create steam or hot water using used in the process, and in some else, these sources of power are sent to the locality demand side in order to provide a part of necessary thermal power particularly for heating space.

4) Electrical power savings

Electricity utilization donates to approximately 5% of carbon dioxide production in the cement plant. Roughly 100 kWh/t-cement electricity is necessary in a competent cement plant. By considering coal as the main fuel, we can see that this electricity demand results in creation of up to 100 kg of CO₂ per ton of cement. An example of approach toward power saving is operate adaptable speed drivers instead of typical drivers. This replacement can lead to power savings from 7 to 60% depending on the submission and the load applied to the motors as well as submission in the process.

5) New preheated tower and kiln burners

Developing new and optimized sort of cyclones are probable to save 0.6-1.1 kWh/t-clinker electricity by reducing force drop. Using new and optimized models of burners can also result in fuel saving. Employing these burners can lead to a stable kiln operation, maximizing ignition usefulness, and dipping fuel utilization in the method.

6) Protection

Regular protection can considerably donate to energy saving and accordingly in curbing CO₂ emissions. Actions such as regular leaking monitoring and control, corrosion control, and decrease as well as periodical replacement of old motors and machines can considerably amplify the plant thermo effectiveness. It is estimated that simple air leakage at the kiln hood could lead to roughly 46 kJ/kg-clinker power losses.

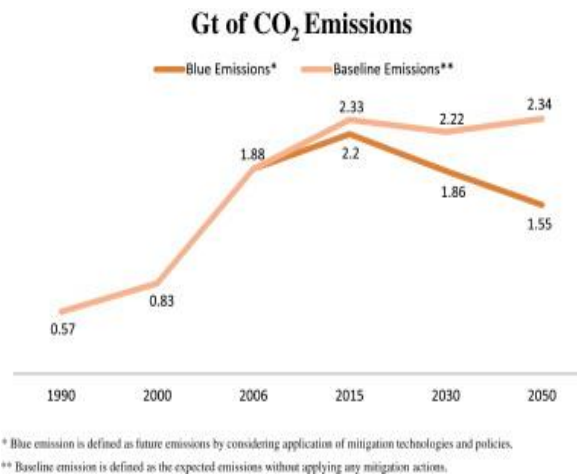


Fig.2 Curb Co2 Emissions in Cement Plant

B. Strategy 2: Post- incineration CO₂ Capture and Storage

Beside all approaches illustrated above, post incineration CO₂ capture and storage (CCS) never really decreases the creation of CO₂. The plan of this treatment is to divide, capture, and to avert CO₂ from being released. CCS is a set of technologies which can significantly alleviate CO₂ production from industrial processes and other inactive sources of CO₂. It is a three-step process which includes imprisons and density of CO₂ from flue gas stream, transport of the captured CO₂ and storage of CO₂ in suitable geologic formations. Though, up to now and due to an assortment of technical and financial barriers, no post- incineration capture and storage process has been applied in cement plant, and a wide consumption CCS in the cement production is not foreseen before 2020.

C. Strategy 3: Developing substitute resources

Developing substitute resources in cement manufacture method is not a new approach. Starting from past decade, developing substitute resources has speedily comprehensive, and due to view of the power and ecological confront, it is predictable to augment even at the faster rate in the opportunity.

1) Substitute fuels exploitation

Profusion of substitute fuels, in dissimilar phases, is being used in international cement plants aiming to gain financial and ecological achievements. These fuels usually include: 1) undeveloped biomass residues; 2) Non-Agricultural biomass residues; 3) Petroleum-based wastes and various wastes; and 4) Chemical and unsafe wastes. Fig. 1 shows the changes in CO₂ emissions by utilize a range of substitute fuels as a substitute of coal.

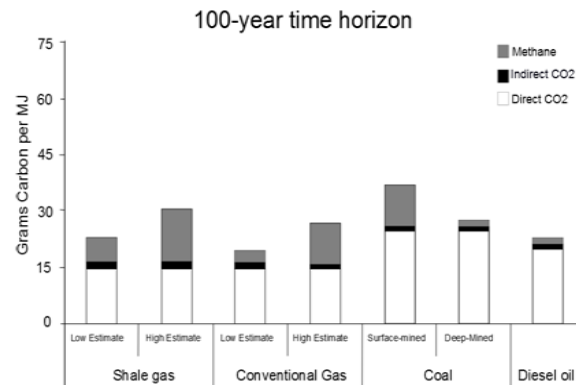


Fig.3. dissimilarity of CO₂ production by exploit substitute fuels evaluate to energy

Among all substitute fuels, exploit waste-derived fuel (WDF) in cement plant seems to be more environmentally forthcoming as it concurrently decreases emissions from both cement plants and landfills. In addition to generating fewer pollutants by using this substitute fuel as a basis of power in cement industry; CO₂ generation is significantly reduced as a result of waste decrease in landfills.

2) Recycle manufacturing by-products as raw fabric and clinker alternate

Reusing industrial by-products is measured as the most talented and sensible solution to diminish gathering of by-products inadvertently produced by industries. Generally, industries treat by-products as the waste and send them to the landfills or incinerators. Otherwise, these by-products can be mixed with raw materials and fed to cement process. Furthermore, these wastes can be alternate with clinker and create a piece of final cement.

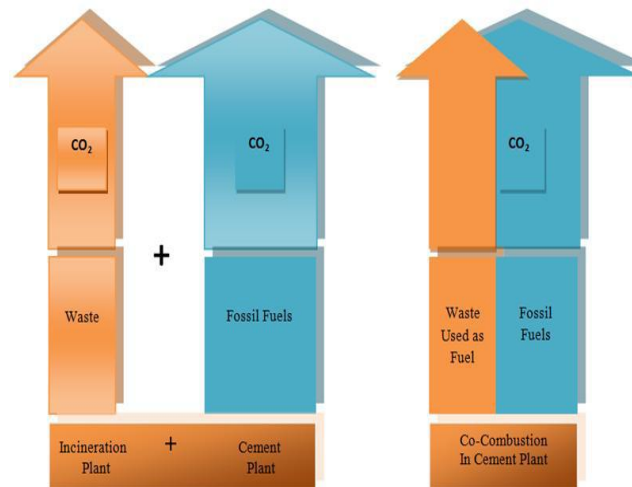


Fig.4. CO₂ reduction by utilizing WDF in cement plant

1.5 CONCLUSION

In this paper, global approach and potentials toward CO₂ emissions decrease in cement plant were firstly discussed compared, and then the most promising approach were introduced. In case of power saving, shifting to

more competent processes, for example from wet to dry process having calciner, was the best option, since it potentially reduced up to 50% of required energy and mitigated almost 20% of CO₂ emissions in the process. CCS is also measured as an efficient way which is potentially able to separate and store major quantity of CO₂ produced in the plant. Though, up to now, and due to a variety of barriers and challenges, no post-combustion incinerate and storage process has been applied in the cement industry. As far as developing substitute resources are concerned, recycle industrial by-products and WDF resulted in the greatest contribution to abate CO₂ emissions. Manufacturing wastes exploit as fuels, raw materials, and clinker substitutes considerably contribute in emission reduction since they simultaneously curb CO₂ emissions from two sources, cement plants and landfills.

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