Use of Alternative Fuels in Cement Industry

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Abstract

Cement plays a vital role in the development of any nation. Indian cement industry is the second largest industry in global market, after China. Housing sector is the key driver of cement in India using 67% of total consumption infrastructure, industrial and commercial constructions accounting for 13, 11 and 9 percent respectively. Concrete is the most used substance next to water with about 100 kilograms used per capita every year. On account of its weight, cement supplying through deportation is very costly and broadly confined to a region within 200 kms of a site.

The origin of Indian cement industry dates back to 1889 in Kolkata. The world war I proved to be helpful in giving a kick start to the cement industry. The growth of cement accelerated in 1956, regulation in price and distribution came into being to ensure fair price system for both consumers and producers. In a developing country like India, there is always great prospect of development of cement industry. cement industry is performing moderately in pollution norms also (SPM of 40 in India against 20 of Japan). Nevertheless, the average performance is not encouraging. For the purpose of a better growth in world market, it must undergo modernization and apply economically efficient energy models and environment friendly technology. It is vital for cement industry to think about other alternative methods. It will hit two birds with one arrow- energy efficient models will help in a reduction of manufacturing cost as well as render a helping hand to the country for sustainable development by using of the industrial waste.

In last two decades, the business grew at a laudable rate, recording a compound growth of 8% although recently the overall growth has been sluggish due to the slow pace of economy. The industry suffers from inherent drawbacks such as high capital cost and long gestation periods. Availability of basic ingredients like limestone reserves also act as an obstruction for growth. A few producers have gone for installation of captive power, but the shortage of coal and other fuels required in production is yet to be resolved. Apart from that, it has to bear the brunt of high operating costs, including all major cost heads such as raw material, energy and freight. Cement as a commodity business and sales volumes for the majority part hinge upon the delivery range of the company. There has been a significant amount of mismatch between demand and supply for a long period which has resulted in lower capacity utilization levels.

As stated earlier, cement is an indispensable part and a key enabler of infrastructure and housing

development- a product that provides the society with what it requires in terms of affordable and comfortable accommodation and reliable infrastructure. The need of introducing alternative fuels as source of energy and power has gained increasing ground and acceptance. It is now seen as an important step in reducing cost of energy, improving uninterpreted energy and importantly managing the carbon footprint. Alternative fuels provide the industry with a valuable resource as well as a complementary source of energy for the traditional non-renewable ones. The co-processing of alternative fuels furnishes an answer in terms of cutting down fossil fuel dependency as well as a contribution towards a reduction in emission. The use of substitute raw materials also multiply gains, including lesser need for quarrying and improved environmental footprint of such activities. Commutation of clinker in cement is a very good example of the commitment of the cement industry to effectively manage its resources and be demonstrably more aware of its social and environmental commitments.

The application of substitute materials in the cement industry reduces global CO2 emissions and hardly has any negative impact on production in terms of energy efficiency. It does not have any detrimental impact on the environmental and technical quality of the final product. Furthermore, co-processing in the cement industry is carried out in a safe and sound manner, hence, not affecting the health and safety of its workers and surroundings.

This research paper is trying to bring in glimpses, the benefits of using alternate fuels in place of conventional fuels in cement manufacturing. Some of the alternative fuels can be petroleum coke, sewage, sludge, used vehicle tyres, meat and bone and agricultural biomass.

Coal and natural gas are fossil and conventional fuels that have traditionally provided most of the energy to the entire world, while nuclear energy is another popular source of energy in a large number of developed nations. Alternate fuels are also available in all forms such as solid, liquid and gas. Conventional fuels are costly and their immensely damaging effect on the environment underscores the need to develop alternative fuels for many industrial systems that rely on fossil fuels. Use of renewable and alternative fuels also contribute in resolving air pollution and helps in creating clean environment and reducing carbon radiations.

Hereby, there is an examination on the types of fuels that can be helpful in protecting environment and socio-economic conditions. The journal will serve as a valuable source of information for cement manufacturers, interested in the subject and researchers for their professional and academic growth.

Thermal energy of the order 3.3 GJ is used for production of cement per ton of clinker. Electrical energy consumption is about 90-120 kWh/tonne if cement. Coal is the conventional fuel which is used in cement industry. Alternate fuels like gas, oil, liquid waste materials solid waste and petroleum coke have been proved as successful sources of energy for firing cement making kilns, either on their own or in various combinations.

Alternative fuels are predominantly agricultural and non-agricultural biomass, hazardous waste. These can be divided under eight broad categories-

- Biofuels
- Natural gas
- Waste derived fuels
- Wind energy
- Hydroelectric power
- Solar energy
- Hydrogen
- Nuclear energy

Biofuels are usually from an organic origin including residues from agriculture and energy crops, coffee husks, straw, sugarcane leaves, rapeseed stems, palm nut shells, rice husks, animal dung, meat and bone meal, animal fat and ethanol and biodiesel from plant material and a lot more.

Solid biofuels should be distinguished from solid fossil fuels which are of biochemical origin, but which are non-renewable and the same goes with liquid biofuels. Biofuels are transport fuels, primarily biodiesel and ethanol. Another form of biofuel is biogas.

Hazardous waste fuels are residues from industrial or commercial painting operations. The examples of which are spent solvents, paint solids, wash solvents, pot cleaners, metal cleaning fluids, machine lubricants, coolants, cutting fluids, electronic industry solvents, oils, resin etc. the list of candidate materials keeps expanding.

Process

Manufacturing of cement is undertaken in a rotary kiln which is a long cylinder rotating on its axis approximately once in every 2 3 minutes. The axis is inclined at an angle, there is a burner on the lower part of it. The material passes through this rotary movement starting at a cool end and ending on hotter end where is drops out and ultimately cools.

There are three stages of a typical manufacturing process:

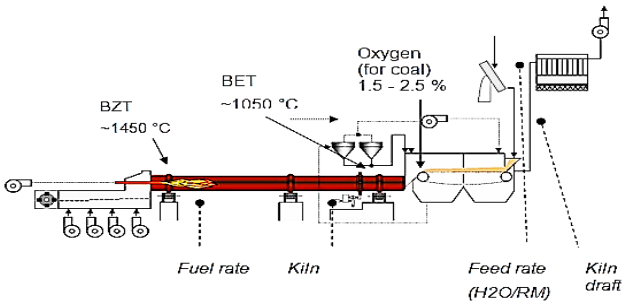
- Rawmix: Grinding limestone and clay or shale
- Heating: The rawmix is heated at a temperature up to 1450 °C
- Clinker: Grinding the clinker to make cement

The second stage consists of the rawmix being fed into the kiln and gradually heated with the hot gases from combustion of the kiln fuel. Chemical reactions take place successively as the temperature increases which are as follows:

- 70 to 110 °C - Extra water is evaporated.
- 400 to 600 °C - clay-like minerals are decomposed into their constituent oxides.
- 650 to 900 °C - calcium carbonate reacts to form belite also known as C2S.

- 900 to 1050 °C - the remaining calcium carbonate decomposes to calcium oxide and CO2.
- 1300 to 1450 °C – partial melting takes place, and belite reacts with calcium oxide to form C3S also called alite.

The kiln system is designed to undertake these processes in order to make cement.



Reference: https://www.cementequipment.org/cement-plant-operation-ccr-operator/kiln-control-operation/

The use if alternative fuels in cement manufacture is also ecologically beneficial, for two reason: the conservation of non-renewable resources, and the reduction of waste disposal requirements. The use if alternative fuels in European cement kilns saves fossil fuels equivalent to 2.5 million tons of coal per year. The proportion of alternative fuels used in cement kiln systems between 1990 and 1998 in some European countries are as follows in order of importance: France 52.4%, Switzerland 25%, Great Britain 20%, Belgium 18%, Germany 15%.

Clinker produced in kiln systems creates favourable conditions for use of alternative fuels. Advantage of using alternate fuels are that they are cost elective along with being environment friendly. Fuels organic part is destroyed and the inorganic part, including heavy metals are trapped and combined in the product when the alternative fuels are used in kiln system. Their use in cement kilns replaces fossil fuels and maximises the recovery of energy. Waste used as alternative fuels in cement plants also helps in keeping the cities clean which helps governments too in making sound waste management policy. This practice promotes a vigorous and thriving material recovery and recycling industry.

Use of Hazardous Waste (HW) as alternative fuels

Use of hazardeous Waste as alternative fuel is also an important factor for generating power, I cement plants. Rajasthan is among seven states of country which generates incinerable HW. State of Rajasthan generates 23025 (5.54%) of India) tons HW per year which can only be used after taking the approval of Central Pollution Control Board (CPCB). The ministry of Environment and forests 9MoEF) has laid down, in the Hazardeous Wastes (Management, Handling and Transboundary Movement) Rules, 2008 (HW rules) under Chapter III Section 11: “The utilization of hazardeous

waste as supplementary resource or for energy recovery or after proessing, shall be carried out by the units only after obtaining approval from the Central Pollution Control Board."

Cement plants of Rajasthan which have the potential of using HW are Ambuja Cement, Ultatech Cement, ACC, JK Cement, Shre Cement, Mangalam Cement and Birla Cement words.

Insufficient availability of the coal is compelling the manufacturers to use alternatives and hence a real positive incentive for all cement manufacturers. Taxes and government levies on cement are high compared to countries in Asia pacific region.

Many municipalities or regions in India don't have established collection and disposal infrastructure for wastes, such as agricultural wastes or municipal solid wastes. Therefore, collection and eventfully processing of such wastes have to be developed by the cement plants or contractors. Use of biomass waste is needed and the available trucks for cement transports can be used.

The use of waste as alternative fuels in the cement industry has numerous environmental benefits:

- It reduces the use of non-renewable fossil fuels such as coal as well as the environmental impact associated with the usage of coal and its mining.
- It contributes towards a lowering of emissions such as greenhouse gases by replacing the use of fossil fuels with materials that would otherwise have to be incinerated with corresponding emission and final residues.
- The use of these resources in cement kilns also maximises the recovery of energy from waste.

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