

ENVIRONMENT SUSTAINABILITY THROUGH TECHNOLOGICAL ADVANCEMENT AND INNOVATION: A CASE FROM INDIAN CEMENT INDUSTRY

Megha Adlakha*
Dr. L.C. Panjabi**

ABSTRACT

The Indian cement industry, having installed capacity of 509 million tonnes per year (mtpa) as of 2018, is world's second largest cement producer. The Indian cement industry is however, globally recognised as one of the most energy efficient in the world, with relatively large production units & the use of cost effective and low-carbon technologies. Almost 99% of the installed capacity in India uses dry process manufacturing, of which 50% has been built in the last 10 years. On the other hand, this industry has heavy footprints on the environment as compare to other industries due to its high energy consumption, emission of GHG (Green House Gases). However, companies have started acknowledged the measures for reducing the exhaustion of natural resources and reducing the GHG emission. They are leading to a more sustainable way of maintaining the balance between environment and business without compromising or neglecting either of them.

Keywords: Sustainability, Environment, Energy Efficiency.

Introduction

A healthy environment is important for success yet human activity & its impact on the environment are threatening the planet's long term ability to sustain the growing population. The world witnessed over exploitation of natural resources in the last century leading to global warming which is demanding challenge for the mankind today. Exhaustion of natural resources and emission of GHG like CO₂, SO₂ etc lead to climate change. Top global corporate have now started working on the strategy based on triple bottom line (3P). 3P stands for Profit, People, and Planet. Corporate have now working sternly toward the aspect Planet i.e., environmental or ecological sustainability. In India, companies have acknowledge the concern of sustainability and therefore demonstrated that by adopting various measures such as replacing water cooled condenser by air cooed condenser, Installation of SNCR (Selective Non-Catalytic Reduction) system for controlling NO_x (Nitrogen dioxide), using alternative fuels and so on. According to management guru C.K.Prahlad, "By creating sustainability as a goal today, early movers will develop competencies that rivals will be hard pressed to match. Don't look at sustainability compliance & regulation but as an opportunity for breakthrough innovation". Cement companies have started publishing their sustainability reports based on GRI G4 guidelines. The Indian cement industry needs an environment that influences companies to adopt mature sustainability strategies such as fiscal incentives for investment.

Meaning and Definition of Sustainable Development

As per World Commission on Environment and development (1987) (Also called the Brundtland Report) "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs." It contains within it two key concepts:

"The concept of needs, in particular the essential needs of the words poor, to which overriding priority should be given." and:

"The idea of limitations imposed by the state of technology and social organization on the environments ability to meet present and future needs"

* Research Scholar, Career Point University, Kota, India,

** Research Guide, Career Point University, Kota, India.

According to IUCN (International Union for Conservation of Nature), UNEP (The United Nations Environment Programme), WWF (World Wide Fund for Nature): "Sustainable development, sustainable growth, and sustainable use have been used interchangeably, as if their meanings were the same. They are not. Sustainable growth is a contradiction in terms: nothing physical can grow indefinitely. Sustainable use is only applicable to renewable resources. Sustainable development is used in this strategy to mean: improving the quality of human life whilst living within the carrying capacity of the ecosystems."

The aim of sustainable development is to balance our economic, environmental and social needs, allowing prosperity for now and future generations. Sustainable development consists of a long-term, integrated approach to developing and achieving a healthy community by jointly addressing economic, environmental, and social issues, whilst avoiding the over consumption of key natural resources. Sustainable development encourages us to conserve and enhance our resource base, by gradually changing the ways in which we develop and use technologies. (www.sustainable-environment.org.uk) The Sustainable Development Goals (SDGs), also known as the Global Goals, were adopted by all United Nations Member States in 2015 as a universal call to action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity by 2030. The 17 SDGs are integrated—that is, they recognize the action in one area will affect outcomes in others, and that development must balance social, economic and environmental sustainability. (United Nations Development Programme).

Following are the 17 Sustainable Development Goals Re:

- No Poverty
- Zero Hunger
- Good Health and Well Being
- Quality Education
- Gender Equality
- Clean Water and Sanitation
- Affordable and Clean Energy
- Decent Work and Growth
- Industry, Innovation and Infrastructure
- Reduced Inequalities
- Sustainable Cities and Communities
- Responsible Consumption and Production
- Climate Action
- Life Below Water
- Life On Land
- Peace, Justice and Strong Institutions
- Partnership for the Goals

Cement companies of Rajasthan, whether large scale or small scale, have adopted measures for reducing CO₂ emission, reduction in power consumption, technical advancement, using alternate sources of energy, replacement or modifications of equipments or machinery etc. Many cement companies have realized the aspect of environmental stewardship and employ several process optimization measures to recycle waste, conserve energy, harvest water, protect and maintain healthy biodiversity, increase green cover, manage hazardous waste. One such company of Rajasthan, Udaipur Cement Works Ltd. (UCWL) is constantly making efforts to stringent energy conservation in its manufacturing processes, having a professionally qualified and well trained team of engineers for installing and absorbing latest technology, machines, equipment and systems for gaining resource efficiency, increasing productivity and delivering superior quality of its processes, products and services.

Udaipur Cement Works Limited (UCWL) is one of the leading cement manufacturing company that has its roots originated in city of lakes, state of Rajasthan, in western India. UCWL is a subsidiary of renowned Indian Cement Manufacturing Company, JK Lakshmi Cement Limited, which is a part of reputed business conglomerate JK Organisation (JKO) that has rich business legacy of more than 135 years. The company has an integrated cement manufacturing unit with installed cement production capacity of 1.6 million tonnes per annum (MTPA). The company has a 6 MW Waste Heat Recovery System that utilizes the waste heat of kiln and helps reducing the carbon footprint of the company by 34058 tCO₂e per year and thereby saving 24724 tons of coal and 113529 KL of water compared to conventional thermal power plant.

The company has also installed a 6 km long Over Land belt Conveyor (OLBC) to source raw material from its captive mine to the manufacturing plant that further adds value in gaining cost and environment efficiency. To strengthen community relationship and to bring sustainable change in quality of life of neighbourhood community through innovative solutions in Education, Health, Livelihood and Community Development. CSR activities are being carried out mainly in eight nearby villages of plant and mines areas. The company has received the Greentech Safety Gold Award-2017, Certificate of appreciation from National Safety Council of India for appreciable achievement in Occupational Safety & Health for three years period : 2013-15, First runner up for CII Northern Region Inter Industry Competition on environment, Health and safety Management and also achieved the first prize for Publicity & Propaganda in Mechanized Opencast Mines (Group-A1) during Mine Safety cleanliness and Silicosis Awareness Week 2017.

Literature Review

Ali et al. (2011) found different sources of emissions in a cement industry, they suggest some techniques to cut down CO₂ emissions, reducing clinker/cement ratio by replacing clinker with different supplement or add-on and using alternative fuels instead of fossil fuel.

Amrina and Vilsa (2015) introduced a set of key performance indicators for evaluating sustainable manufacturing in the cement industry based on the triple bottom line of sustainability, viz. Economic, social and environmental dimensions. They used the Analytical Hierarchy Process to derive weights for the criteria, as well as sub criteria.

Laskar et al. (2017) found very high level of disclosure of sustainability practices among the Japanese companies, as compared to a very low level of the same among Indian companies. They also found that the environmental factor is dominant among the Japanese companies and among Indian companies social factor is dominant. They found substantial positive impact of corporate social performance on financial performance.

Objective of the Study

The study is done to address the following objectives:

- To study the steps taken by the company for conserving energy.
- To study the technical innovations adopted by the company.

Methodology of the Study

The present study has been based on a company named Udaipur Cement Works Limited (UCWL). The data for the paper, which has been collected through various sources like Annual Reports of the company, Sustainability reports, Newspapers and Magazine articles etc, is secondary and is classified in broadly two categories namely Conservation of Energy and Technical Absorption, Adaptation and Innovation by Technical Adaptation.

Research Gap

Many studies have done on sustainability in the cement sector, but those are mainly restricted to some top cement companies. Not enough study has been done on small companies or a thorough study showing the awareness or acknowledgement taken by the small scale companies. There is a need to present that not only the top corporate, small and medium scale companies are also becoming more responsible towards the aspect of Planet and Sustainability.

Steps taken by Udaipur Cement Works Limited for the financial year 2015-16

Ñ Conservation of Energy

UCWL took following initiatives with a view to conserve energy and reduce fuel consumption:

- Implementation of PID (Proportional Integral Derivative) loops for OPC (Ordinary Portland Cement) grinding to conserve power.
- Optimization of Silo aeration blower in Packing Plant to conserve power.
- Increase in fly Ash absorption in blended cement by optimizing cement Mill operations & particle size distribution with improved quality & strength.
- Mechanical bag diverters installed in place of motorized bag diverters to conserve power
- Provision of VFD (Variable Frequency Drive) is kept in Vertical coal Mill main drive, so that mill will draw optimum power on different type of fuel grinding.

Ñ **Technology Absorption, adaptation and Innovation by Technical Adaptation**

- In-house development and installation of bulk loading system for PPC (Pozzolana Portland Cement) in Packing plant
- Replacement of old technology electrical circuit breakers by latest vacuum circuit breaker.
- Installation of high level indicator in material feeding belt discharge chute to ensure trouble free running of pre-crusher
- In-house fabrication of truck loader number 3 to facilitate nonstop belt changeover and minimum loading time
- Modification in oil seal of cement Mill Separator to avoid frequent leakages of oil and breakdown of separator.

For the financial year 2016-17

- **Conservation of Energy**
 - Optimization of water spray systems in vertical raw mill to avoid mill vibration and to improve running hours.
 - Optimization of Pyro Compressor uses.
 - Modified cooler blaster logic to avoid snowmen formation.
 - Optimization of cooler stroke length to reduce clinker temperature.
 - Modified cooler water spray logic for effective operation of ESP (Electrostatic Precipitation)
- **Technology Absorption, Adaptation and Innovation by Technical Adaptation**
 - Installation of fresh air damper in PH don comer duct.
 - Increase in height of top cyclone dip tube to lower return dust percentage.
 - Retrofitted the existing VCM (Vertical Coal Mill) with increased table speed, modified roller and new upgraded classifier.
 - Retrofitted the existing VRM (Vertical Raw Mill) with increased table speed, modified roller and new upgraded classifier.

For the Financial Year 2017-18

- **Conservation of Energy**
 - Increased power generation from WHRS (Waste Heat Recovery System) circuit through various in-house modifications and optimizations like, dummy installation in cooler vent duct, reducing false air in pre heater, WHR operation from two fan system to one fan system to reduce auxiliary energy consumption, etc.
 - Reducing energy consumption by 0.7Kwh/Ton in operation of VRM product circuit by optimization of running of Air Slide blowers and reducing false air ingress.
 - Installation of motion sensors in offices for energy conservation.
 - Installation of Energy Efficient LEDs in place of conventional CFLs in packing plant section.
 - Reduction in energy consumption to the tune of 48000Kwh/annum in VRM product circuit by optimization of running of Air Slide blowers and reducing false air ingress.
- **Technology Absorption, Adaptation and Innovation by Technical Adaptation**
 - Installation of VFDs in various fans/drives for conservation of energy.
 - In-house designed Heat Tracing Arrangement for fine coal bins for improved flowability of coal and reduced tendency of coal flushing thereby easing operation.
 - In-house modification of wiring scheme to enable standby mode for power saving during unload condition of compressors.
 - In-house designing of PID Loops in Cooler Water Spray System for effective cooling of hot clinker.
 - In-house optimization in coal mill bag house through automation of purging time for operation flexibility and energy saving.

For the Financial year 2018-19

- **Conservation of Energy**
 - **Steps taken for Conservation of Energy**
 - Installation of new by-pass belt conveyors in crusher and OLBC (Over Land Belt Conveyor) section to reduce number of operating belts.
 - In house modifications to achieve WHR section's auxiliary power consumption less than 5%.
 - Replacement of reciprocating compressors in packing plant with screw compressor.
 - Installation of variable frequency drives (VFDs) in various sections like Vertical Raw Mill (VRM), Vertical Coal Mill (VCM), Pyro, Waste Heat Recovery (WHR), Cement Mill and Packing Plant.
 - Modifications in VCM cyclone to increase dust collection efficiency to reduce power consumption in VCM section.
 - **Steps taken by the company for utilizing alternate sources of energy**
 - Use of Liquid Alternative Fuel.
 - Liquid AFR (Alternative Fuels & Raw Material) system in kiln.
 - In-house innovative modifications to enhance WHR based power generation to the tune of annual average of about 35 units per ton of clinker thereby fulfilling about 40% of the total operational power requirement from WHR based generation.
 - **The Capital Investment on Energy Conservation Equipment**

S.No.	Particulars/ Equipment Names	Investment Amt. (₹ in lakh)	Saving/Year (₹ in lakh)
1.	VFDs in Boiler Feed Pump & condensate exhaust pump in WHRS	5.0	10.0
2.	VFD in Bag Filters of Cement Mill & Packing Plant	3.8	9.3
3.	VFDs in bag filters & water spray pump in pyro section	2.2	8.7
4.	Replacement of old water pump with new high efficiency submersible water pump at mines water pit	1.0	7.9
5.	Reduction in idle running of jaw crusher by installation of rock breaker at crusher I/L	12.0	19.3

- **Technology Absorption, Adaptation and Innovation by Technical Adaptation**
 - **The efforts made towards technology absorption**
 - Installation of technologically advanced water spray system in crusher section to optimize power consumption in dust extractions systems.
 - Relocation of bag house fresh air damper with innovative sealing arrangement to minimize false air entry.
 - In-house modification carried out in kiln coal firing burner to optimize primary air requirement and to increase flame momentum thereby reducing thermal NOx generation etc.
 - Installation of SNCR (Selective Non-Catalytic Reduction) system for control of NOx.
 - Commissioning of in-house fabricated air cooled TAD hoisting damper flap to minimise clinker temperature.
 - In-house repair and maintenance of VRM feeding rotary feeder to minimise false air entry.
 - **The benefits derived like product improvement, cost reduction, product development or import substitution.**
 - Turn around time for out bound trucks improved
 - Installation of in-house developed system, consisting of flow meters and other instruments, in hydraulic lines of VRM rollers to ensure proper flow of lubrication in the rollers.

- Installation of innovative in-house developed hydraulic arm based rock breaker mechanism, an import substitute to minimize breakdown time in Jaw Crusher Section.
- In-house development and commissioning of packer double discharge mechanism to optimize packer capacity.
- **In case of imported technology**
The details of technology imported:
 - Boiler, Turbine and Generator Set for WHRS
 - Sinowalk Cooler for Pyro process
 - Jaw and Cone Crushers for mines
 - Hydraulic System for raw mill
 - Hydraulic System for coal mill

Conclusion

The company has been continuously aiming new technological adaptations not only for business profits but to ensure more transparent actions for the environment. Maintaining technological excellence through in-house innovation and creativity has been the focus area for the company. UCWL, with increase in its production and sales capacity, has also increased its efforts for sustainability by espousal of the concept of eco-sufficiency. By investing in energy conserving equipments it has not only cut down the energy consumption but also gain monetary benefits. It can be concluded, by the analysis of the above mentioned aspects, that cement companies are well aware of their operations and its impact on the environment and society at large and are addressing this issue earnestly. Many national and international initiatives and standards are pushing corporate to comply with regulations and companies are giving their share to the demand. However there is need of more accountability for companies on their part to work beyond compliance requirement to sustain growth in India. The study suffers from some limitations. The research period selected for the study contained years from 2015-16 to 2018-19, which may have contaminated the result of the study. In addition, the study considered only an individual company, hence it does not represent the entire cement sector.

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