

Indian Cement Industry on Path of Environment Sustainability through Innovation and Resource Optimization

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Abstract: India is world's second largest producer of cement. Its installed capacity as on December 2015 was 390 MTPA. Approximately 5% of total global man-made CO₂ emissions are caused due to cement production. As the demand for cement is forecasted to continue increasing worldwide, particularly in emerging economy like India where housing and infrastructure is booming. In terms of environment sustainability, cement production requires water for cooling heavy machinery and exhaust gases, as cement plants are often located in remote areas; they draw water from community sources which can create potential conflict with the communities. The cement industry has a huge impact on the environment as compare to other industries due its high energy intensity leading to GHG emissions. As on today cement as binding material in construction activities has no substitution, it will instrumental in terms of urban development in future. Product innovation and operational efficiency measures leading to reduced resource consumption of water and energy and reducing GHG emissions are the best ways forward. Key factors for sustainability in cement industry are: energy and water consumption, material and resource management, reduction in GHG emissions and waste management. The viable solutions are green power generation, reducing reliance on depleting fossil fuels and using alternative fuels and raw materials, Enabling water conservation, Energy efficiency, transparent CSR reporting, Membership of global sustainability initiative such as Cement Sustainability Initiative (CSI), Environment Biodiversity protection, Negating impact of GHG emissions and setting Targets of sustainability for future. Indian cement industry is most energy efficient in the world. Some cement companies have demonstrated that by replacing water cooled condenser by Air cooled Condensers, water can be conserved. Cement companies have started publishing their sustainability reports based on GRI G4 guidelines. The transparency in CSR reporting in cement industry is increasing. CDM projects of cement companies registered in India resulted in annual CO₂ emission reduction of 21 lac tones. The cement industry needs an environment that incentivises companies to adapt mature sustainability strategies and facilitate transition of cement companies towards becoming architects of sustainable business solutions, such as fiscal incentives for investment in low carbon technologies and products, amending policies for trans-boundary movement of industrial waste etc. This study aims to do critical evaluation of Indian cement industry using action research based methodology in context of environmental sustainability aspect as part of their corporate strategy and CSR commitments.

Keywords: Sustainability, Cement, CSR, Innovations

I. INTRODUCTION

The twentieth century witnessed over exploitation of natural resources by corporates worldwide leading aftermath s like global warming which is pressing challenge for the entire mankind today. Depletion of nonrenewable natural resources like fossil fuels and emission of GHG gases like CO₂, SO₂, and NO_x lead to climate change This has a serious questions on sustainability of current business models of corporates focusing only on economic profit. India has witnessed a disturbed monsoon time table leading to either drought or untimely rain in most of the states. The onus on the reckless destruction of natural resources by corporates. A time has come when stakeholders have started questioning sustainability of corporates in the wake of reckless exploitation the mother earth. Top global corporates have started working on strategy of corporate sustainability based on triple bottom line (3P). 3 P stands for Profit, People and Planet. Out of the basic principles of CSR corporates have stated working seriously on aspect of Planet i.e. ecological or environmental sustainability. Employing CSR principles based on environment sustainability will help companies not only in terms of compliance but will also give a competitive edge. According to Management Guru C.K Prahalad "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 and regulation but as an opportunity for breakthrough innovation."

II. RESEARCH METHODOLOGY

The objective of this research is to evaluate the Indian cement industry in terms of its performance to mitigate environmental degradation as cement industry is a measure source of CO₂ emission (appx 5% of total nationwide CO₂ emissions) and extensive user of natural resources, water and energy.

In this study content analysis of Sustainability Reports of Cement companies available in public domain is done rigorously based on various parameters encompassing environment sustainability. For other companies not publishing their sustainability reports, disclosure on their

websites and annual reports regarding environment initiatives are studied. CSR Hub is a private database company which provides corporate social responsibility and sustainability ratings and information for companies worldwide. The CSR Hub website data is also used to draw the required inferences.

III. CEMENT INDUSTRY IN INDIA

Cement industry plays a crucial role in economy in terms of building social structures like houses, schools, government building, roads and infrastructure like highways, airports, dams etc. With installed capacity of 390 MTPA in 2015, India is

second largest producer of cement in the world after China. With growing industrialization and urbanization and ongoing projects like Smart cities the demand for cement is increasing and cement manufacturing companies are trying hard to cope with the rising demand by building newer capacities. Since 2000 there has been high FDI investment in Indian cement sectors. Entry of Foreign players like Holcim, Vikat, Lafarge, and Heidelberg Cement speaks loudly about the potential of cement Industry in Future India. Table 1 gives an overview of the major players of Indian cement industry in terms of their revenues and installed capacities

Table 1.Cement Industry Overview

Top 12 companies of Cement Industry in India in terms of Installed Capacity and Revenue									
Sr.No	Company	Net Sales(in crs)	Net Profit(in Crs)	Capacity in MTPA	Sr.No	Company	Net Sales(in crs)	Net Profit(in Crs)	Capacity in MTPA
1	UltraTech Cement	23418.01	2014.73	69.3	7	Ramco Cements	3728.56	242.35	16.45
2	ACC	11762.96	591.57	24.24	8	Birla Corp	3,421.34	157.35	9.3
3	Ambuja Cements	9160.35	807.56	29.65	9	J. K. Cement	3,409.48	156.92	12.6
4	Shree Cements	6635.06	426.33	25.6	10	JK Lakshmi Cem	2,314.52	95.6	8.3
5	Prism Cement	5701.91	14.7	5.6	11	OCL India	2,281.72	113.69	25
6	India Cements	5701.91	29.45	15.5	12	Heidelberg Cement	2,146.11	59.53	5.4

Source: Company's websites and annual reports

CSR Hub provides corporate social responsibility and sustainability ratings and information on 16,320+ companies from 135 industries in 133 countries. Table 2 demonstrates CSR performance scorecard of major cement companies. Table 2.CSR Score card of Indian Cement companies

Table 2 provides information about CSR-Hub scorecard of cement companies. Most of the companies are doing reasonably good in terms of Environment aspects of CSR.

CSR-Hub Score Card of Indian Cement companies as on June 2016						
Company	Environment	Community	Employees	Governance	Total	Average
Ultratech Cements	63	51	65	52	231	57.75
Shree Cements	62	50	58	52	222	55.5
Ambuja Cements	66	53	60	55	234	58.5
ACC Ltd.	66	56	66	63	251	62.75
JP Associates	55	53	58	53	219	54.75

Source: www.csrhub.com

Table 3 provides data pertaining to spend on sustainable initiatives and environmental reporting by cement companies.

Cement companies are spending sizable percentage of their profit on sustainability measures.

Table 3: Sustainability reporting of cements companies.

Sustainability reporting and Spend of cement Companies					
Company	Net Profit in Crs.	Investment on Environmental Initiatives in Crs.	Percentage of spending on Environmental initiatives	Sustainability Reporting since	Sustainable Reports till 2015
Ultratech Cement	2,014.73	219.60	10.89	2008	8
ACC Cements	591.57	111.00	18.76	2008	8
Ambuja Cements	807.56	42.00	5.20	2008	8
Shree Cements	426.33	25.68	6.02	2005	10
J. K. Cement	156.92	5.15	3.28	2013	2

Source: Sustainability Reports of the companies

IV. ENVIRONMENTAL IMPACT OF INDIAN CEMENT INDUSTRY

.Out of the total CO₂ emission caused due to human activities, approximately 5% is caused by Cement industry worldwide. These emissions are released in course of activities like clinker production, fuel consumption in cement kilns, use of coal in captive power plants and supply chain operations. With the ever increasing installed capacity the threat of CO₂ release has now become major concern of cement industry which requires immediate attention. Apart from CO₂ other Green House Gases (GHGs) like Sulphur Dioxide, Nitrogen Dioxide are also amplifying the problem of emissions and its ill effects like ozone depletion. Global warming, acid rain and various health issues.

The cement industry is one among the highly polluting 17 category industry and requires consent for establishment and operation under water and air prevention & control of Pollution Acts. In December 2014, the CPCB identified 17 sectors as highly polluting, including the cement industry. Cement plants are classified RED category industries for their requirement of natural resources, combustion process, calcination chemistry of clinker, requirement of more energy and historical impact on the ambient air quality. The material balance of cement mill is negative with 1.45 tonne of raw materials for 1 tonne of cement production. Suspended Particulate Matter (SPM) in emission and extensive use of water are historically known as major environmental concerns of cement industry.

V. NOTABLE INITIATIVES FOR SUSTAINABILITY IN INDIAN CEMENT INDUSTRY

Cement Sustainability Initiative (CSI)

World Business Council for Sustainable Development (WBCSD) and 25 cement manufacturing companies have started this initiative to address burgeoning issue of environmental degradation due to their operations. Through

this initiative the members shared their experiences and best practices in the quest for better environmental performance in cement plants.

ACC, Ambuja Cement, Dalmia Bharat Cement, Jaypee Cement, My Home Industries Ltd., Heidelberg Cement India, Lafarge India, Shree Cement, Shree Digvijay Cement, Ultratech, and Zuari Cement are currently member of CSI.

CSI has helped cement companies gain a better understanding of the cement industry's stakeholder segments and the issues that are material to each segment. Disclosure on the guideline parameters of CSI helps them compare their performance vis-a-vis industry benchmarks.

The Technology Roadmap

WBCSD, CSI and the International Energy Agency (IEA) have jointly developed a roadmap for carbon emission reductions for cement industry. For reducing carbon emissions it has identified five key drives viz. Reduction of clinker in cement composition, Use of alternative raw materials, Alternative Fuels, Waste heat recovery during operations, Energy efficiency measures and latest state of the clean technologies. The project is partly funded by International Finance Corporation.

Environmental Reporting

Maintaining transparency through appropriate reporting, and monitoring it at board level, increases the trust of stakeholders and customers and positively influences the company's reputation and brand equity. Companies publically report on the processes and tools used to identify and prioritize critical environmental issues within the sustainability strategy, including a consideration of impact on the company's business performance.

Environment Reporting is important tool in the hands of companies to exhibit their commitment towards environment sustainability to the stakeholders. A transparent and authentic reporting enhances the public image, reputation and creates a

good brand value for the company. Through these report companies communicate to their stakeholders about their policies, strategies, tools and processes and the results obtained towards their environmental performance. GRI is an international organization which provides the standards for corporates worldwide for their environmental reporting. In Indian Cement industry Ultratech, Ambuja Cement, Shree Cement, ACC and JK cements are publishing sustainability reports based on GRI 4.1 guidelines.

The Business Responsibility report

As per Securities and Exchange Board of India (SEBI) ruling in 2012, it is mandatory for the top 100 listed companies in terms of market capitalization in India to disclose their Business sustainability report along with annual report. Ultratech, Ambuja Cement, Shree Cement and ACC are publishing their BR reports as per based SEBI guidelines since 2012.

GHG India Program

GHG India program is a joint initiative of CII, TERI and WRI India. Currently 32 Indian corporates are members of this program. The program provides tools and techniques to its members to measure its total GHG emissions in terms of Scope 1, 2 and three and also suggests measures to mitigate GHG emissions to make business more profitable as well as sustainable. Currently ACC Limited, Ambuja Cements Limited, Shree Cement Limited, Ultratech Cement Limited are corporate members of India GHG program.

Perform - Achieve - Trade (PAT) compliance

PAT is Energy Conservation drive launched by BEE (Bureau of Energy Efficiency) It is part of National Mission for Enhanced Energy Efficiency launched by GOI. Target is given by BEE to reduce from baseline figures in a span of three years. PAT is applicable for energy intensive industries. It covers 563 designated consumers in eight sectors including cement industry. Energy Saving (ES) Certificate is issued to a participant, who achieves target reduction from baseline. A participant who fails to achieve the target, penalty linked with value of non-compliance is imposed. This ES Certificate can be traded to others who fail to meet their target.. Special trading platform is created in the two Power Exchanges (IEX and PXIL).

GreenCo Rating

GreenCo Rating System is instituted by CII provides a holistic framework to evaluate industries on their environmental performance. Vasavadatta Cement, Sedam was awarded GreenCo Gold by the CII for the year 2012-15. It is the first cement plant to be certified under GreenCo. ACC's Thondebhavi Cement Works rated GreenCo Silver. GreenCo emphasises the need to have an energy policy, formation of cross-functional energy management cell, energy metering and monitoring systems, setting internal, national and

international benchmarks and equipment wise efficiency monitoring.

Clean Development Mechanism (CDM) projects

CDM is one of the Flexible Mechanisms defined in the Kyoto Protocol (IPCC, 2007) that provides for emissions reduction projects which generate Certified Emission Reduction units (CERs) which may be traded in emissions trading schemes.

CDM is innovative mechanism originated from Kyoto Protocol. Companies through their projects and process improvements can reduce their carbon footprints and in lieu of this they get Certified Emission Reduction units (CER) units which can be sold to companies who are creating emissions. CSR is a good source of revenue for companies who are reducing their carbon emissions. ACC, Shree Cement and Ultratech have registered CDM projects and earning good revenue by trading their CERs.

VI. ENVIRONMENT INNOVATION BY INDIAN CEMENT COMPANIES

Green Alternatives to River Sand by Ultratech Cement

In the recent past, Ready Mix Concrete manufacturers have faced acute aggregate shortages owing to the government ban on mining of natural river sand because of its environmental effects. Through its Nano technology R7D initiatives Ultratech claim to produce alternative to river sand.

Stronger Affordable Homes with RMD Technology by Ultratech Cement

Ultratech's Rapid Monolithic Disaster Proof (RMD) Technology is highly suitable for urban, semi-urban and rural mass housing project as it can deliver superior quality homes in just seven days' time. This speed comes at a cost which is same as that of the conventional method. Such homes are also more durable and sustainable than conventional homes. This pioneering technology has seen Ultratech Cement as a partner in a number of government backed mass housing projects as a Technology Provider. Ministry of Urban Planning and Poverty Alleviation has also adopted this technology in delivering houses through State Slum Clearance Boards at various locations.

White Topping Technology by Ultratech

White topping concrete is a Portland cement concrete based layering alternative for existing asphalt roads, and is a revolutionary alternative to traditional asphalt overlays. It enhances the durability and ride quality of a road, is completely recyclable, lasts longer and is cost-effective. It is a sustainable choice for making urban roads and national highways. The Bangalore Mysore Infrastructure corridor project is one of the largest white topping projects in the country and perhaps across the world.

GPS based Operator Independent Truck Dispatch system (OITDS) by Shree Cement

Shree cement is using GPS based system by which it can track the trucks and other vehicle's movement in their mines resulting in efficient utilization of its equipment's, improvement in its productivity, safety of workers and reduction in dust particles and emissions.

Installation of Turbo blower in place of compressor in coal firing by Shree Cement

The Traditional compressor used in in cement kin consumes high power. Shree cement has replaced the compressor by turbo blower running at speed of 3000 rpm as against conventional blower running at a speed of 1500 rpm consuming one third of power. This measure has not only resulted in lesser power consumption but also reduction in carbon Dioxide and saving of INR 19 lacs for the company.

The Plant Environment Profile (PEP) system by Ambuja Cement

Ambuja Cent has developed this system to assess the environmental performance of their plant. It is a scoring system in which a structured questionnaire is delivered to employees and operators on line. The questionnaire is based on environment parameters like water, waste, power, energy, emission reduction management etc. Based on the feedback, the score is calculated and is used to evaluate the environmental performance score of each plant and also used as benchmark for other plants. The scheme is also tied with Environmental KPIs of the employees

Captive power plant using multiple biomass power generation technology by Ambuja Cements

This captive power plant is one of its kind in India. It uses 20 types of biomass waste as alternative fuel in its specially designed furnace. The type of biomass wastes are varied in nature like rice husk, wood chips, cow dung which is easily available in nearby villages. This biomass fuel generates 20% of electricity. Due to this technique the use of traditional fuels is avoided which results in reduction of carbon dioxide and effective and economical use of waste.

True Value Concept by Ambuja Cements

Ambuja Cement claim to innovate a new concept True Value with Consulting firm KPMG. The true value is not only economic value that company has created through its operations but also takes into account social and environmental value that is either added or destroyed through its operations and CSR activities.

Rainwater Harvesting at Vikram Cement works by Ultratech Cements

Khor village in Madhya Pradesh is a water-starved region. The villagers had to travel miles to fill few pots of water. In

summer, the situation used to become really grim. The entire area had several old mine pits which could be repurposed to harvest rainwater. The team examined the local drainage system and seasonal nullahs around the mining area. They constructed check dams and canals for controlled diversion of water into mine pits from seasonal nullahs. It recharged the local aquifer, which in turn resulted in higher agriculture yield for the villagers Water was made avail Around 15 villages consumed this water during summer able round the year to three nearby villages through a pipeline.

Process Water Consumption reduction at Thondebhav plant by ACC

At Thondebhavi Cement Works the process parameters are optimized to eliminate the use of water in the grinding process. The Vertical Rolling Mill does not require much water in the process of grinding clinker. The company claims that its specific water consumption of the plant has reduced from 246 (lts/tonne of cement) in year 2011 to 25 (lts/tonne of cement) in year 2014.

Receipt of certification on sustainable product labelling, 'PRO-SUSTAIN' by Ambuja Cement

DNV, global certification company, gives a cerfication "Pro-Sustain "to companies who use innovative and cost effective methods to gain environmental sustainability in terms of products, process, production, supply chain management and product design. Ambuja cement has been awarded this certification for its Darlaghat Cement plant.

VII. CHALLENGES FACED BY INDIAN CEMENT INDUSTRY

Fuel availability and prices:

Coal is the primary source of fuel for the captive power plants and cement plants. Shortage of coal supply, quality of coal, and volatility of fuel prices remain a major concern for the sector. With dwindling production of domestic coal supplies, coal linkages for cement companies is expected to decline further on account of coal linkages being offered to power producers coal linkages are likely to be minimal. In Union Budget for year 2014-15, Clean Energy Cess on coal has been raised from INR 100 per tonne to INR 300 per tonne resulting in rise of overall power and fuel cost of the cement companies.

Significant policy changes:

It has impacted cement business with regard to environmental performance and costs. The New Environment Rules imposed in August 2014 have some challenging standards for particulate and gaseous emissions. Latest dictum given to cement plants to reduce the emissions of SPM to less than 30 mg/Nm³ by CPCB is very challenging. High investment costs are required for compliance.

Problem in the availability of limestone reserves:

The forecast says, with the current level of capacity utilisation, the limestone reserves may last for only the next 35-41 years. That is an area of concern.

Use of fly ash unviable:

Use of Fly ash in production of cement is an effective method to reduce carbon footprint as fly ash is a waste generated out of captive power plants of cement companies. Fly ash if not disposed off creates a lot of environmental nuances. Earlier cement companies used to get this fly ash free of cost from power companies but after dictum from MOEF, they have to pay to the power companies. The problem gets with multiplied with another rule of MOEF dictating cement companies to give 20% of their fly ash to brick manufacturers. This has impacted the availability of fly ash for cement plants as well inflated the production cost of cement and clinker.

VIII. KEY DRIVERS TO ADDRESS CLIMATE CHALLENGES

Managing Climate change Risk

To address climate change issue cement companies have undertaken a series of initiatives like Replacement of traditional fuels with alternative fuels, Implementation of Waste Heat Recovery systems at multiple locations, Installation of online monitoring systems at all integrated plants, Improvement in energy efficiency through plant and process modernization, Usage of clinker additives to reduce the amount of clinker produced Cement Companies are reducing carbon footprint of cement production by employing different methods like waste heat recovery, alternate fuel firing, installing solar panels on major building roofs and producing blended cement.

Sustainable Supply Chain Management

By judiciously and innovatively designing its supply chain operations, company can attain objective of sustainability along with its business partners.

ACC has included various clauses related to environmental CSR aspects in its contracts with suppliers. Company clearly communicate to its suppliers its expectations in terms of CSR, Legal and sustainability and expect all supplier to strictly adhere to those standards.

Shree cement is also doing appraisals of supplier on Sustainability factors Sustainability components in all contracts. Ambuja cements is using an initiative SCOPE to improve its logistics and supply chain management. Ambuja use own fleet of ten ships for movement of its raw material and finished goods through sea route which is environmentally beneficial SCM strategy resulting in logistics cost.

Waste Management

Both Ambuja cements and ACC which are now subsidiaries of Hoicim, a Swiss cement giant are using waste from municipal, industrial, agricultural entities in their cement kiln for co-processing as a alternative fuel .This has dual benefit – economic benefit to cement companies in terms of fuel cost reduction, reduction in use of traditional fuels and also benefits to society as large to address burgeoning problem of waste management at no cost.

Most of the cement companies are using flyash and slurry as alternative material for producing blinding cement. Concrete recycling is also done to extract water and limestone in the cement plant. The water recovered from recycling is used for production or other uses.

Water Management

Water is renewable but limited natural resource. With a huge population of 1.25 billion, water conservation and management is going to be daunting task in India.

Cement plants require water in their operations for cooling machineries and equipment and also in their captive power plants for cooling generators and power equipments. Besides that water is required for workforce and colonies of cement plants. If cement companies are located in water scarce locations like Rajasthan, a potential conflict may arise for water with local communities which are a big future challenge.

Ambuja cement has constructed check dams near their plants to arrest water flow and to allow storage of it. Reuse, recycling of water and zero discharge is their approach towards water management. Monthly they create a report of water usage and keep vigil on water usage.

Similarly JK Cement is also reusing the waste water and recycling it to maintain zero water discharge and thus conserving it very carefully. Shree cement is also working on the same line towards zero discharge of water through recycling and waste water treatment.

Ultratech conserve, recycle and reuse water at all units and plants. Rainwater harvesting, groundwater recharging, recycling wastewater and reducing the usage of fresh water are standard operating procedures at their manufacturing plants. ACC has installed automated water measurement systems to capture meaningful information about water performance relating to water withdrawal and water consumption.

Energy Management

Cement production require fuel of high calorific value operate their kiln and preheaters at high temperature of 1500 degree celcius. Coal is the prime fuel which is cheap but emits high carbon dioxide. Petcoke, Agro waste, furnace oil are other alternative fuels used for creating energy for operations.

Ultratech is concentrating on three focus areas: Energy efficiency via process efficiency, Waste Heat Recovery and production of Renewable Energy.

Waste heat recovery (WHR) is now a strategic part of power projects in all operating integrated plants and upcoming projects of all top cement companies. Ultratech generated 4 MW of power through solar panels and wind mills. Shree cement is having all kilns equipped with Waste Heat Recovery (WHR) arrangement and a decision has been taken at SCL to install all new kilns with a WHR arrangement. Energy Efficiency initiatives implemented by cement companies are: Use of alternative fuels such as Carbon Black and Agro Waste, Reduction in Thermal Energy of Kiln by operational modifications & improvements, Installation the Variable Frequency Drives etc.

Materials Management

Companies like Shree Cement are putting more stress on their Research and development activities to search for cost effective and efficient raw material and alternate fuel

ACC is using slag and Fly Ash to make superior blended cements. Cement companies are using flyash ash and slurries as substitute for raw material to reduce its carbon footprints as well its production cost. JK Cement's focus lied on increasing the use of Fly Ash and Slag in Grey Cement manufacturing, resulting in increased consumption of these materials on absolute and on per ton of Grey Cement basis. Some plants have substituted mineral coal with petcoke, for kiln burning. Besides the cost savings, the use of petcoke enables use of low or marginal grade limestone as raw material which leads to the extension of mine life, natural resource conservation and reduction in CO₂ emissions.

Cement companies are experimenting with industrial and municipal solid waste and bio-waste like tyres, plastic, wood chips, rice husk etc. to be used as alternative raw material in co-processing mode.

Process Optimization

Optimization improves better use of fuel and power per ton of cement produced. Process optimization brings down power consumed per unit of cement manufactured and it also reduce consumption of other resources like water, cooling air, compressed air and manpower. In wake of the latest dictum given to cement plants to reduce the emissions of SPM to less than 30 mg/Nm³ by CPCB, it is of great importance that the cement plants optimise their processes and bring down the emissions to as low as possible with the existing plant and equipment. If they are able to do that, they will save a lot of money by way of not having to replace the existing equipment with new ones or go for an altogether new technology. In many Cement plants air pollution control equipment like ESP have been converted to pulse jet type of bag filter or a hybrid of ESP and bag filter combination to achieve the collection

efficiency desired and also to comply with the emission norms. They have also debottlenecked the process and increased the mill through put.

Biodiversity Management

In recent past, cement companies had been charged for in terms of destruction of biodiversity, flora and fauna in their mining and production area. Cement companies are trying to address these allegations with measures like tree plantations, creating green belts in and around plants and mines and trying to arrest dust emissions in their mining operations. Ultratech planted 240,556 saplings and meticulously maintained them to achieve a survival rate of 85.81%. Shree Cement planted around 70000 plants in a year 2014. ACC estimated 1 lakh trees were planted in 2014.

Mining

Mining operations of cement companies are big threat to surrounding ecosystem if not done scientifically. The reckless mining cause water pollution both ground as well as surface water. Air pollution, vibrations during blasting, deforestation, erosion of fertile soil, damage to flora and fauna are ill effects of mining operations.

Ambuja cement use modern mining technologies like surface miners and over land belt conveyor to arrest these ill effects of mining in its plants. JK Cement has converted the dry drilling into wet drilling. They use Sequential Blasting Machine to reduce noise, vibration and dust emissions in their mining operations. ABG Cements also use surface miner technique to eliminate noise producing mining operations blasting and crushing of lime stone. Shree Cement has a rehabilitation and restoration plan for all mining area. All mining operations at ACC are carried out as per the mining plans duly approved by Indian Bureau of Mines (IBM).

IX. SUGGESTIONS

To policy makers:

1 An appropriate amendment to the Hazardous Waste Management (HWM) Rules is required so that pre- and co-processing can be efficiently undertaken by the cement industry, in gainfully utilising the wastes.

In developed countries cement kilns are used as a viable and cost effective option for industrial and municipal waste and offer alternative to traditional waste management like landfilling and incineration which leads to GHG gases emissions. The producers of such wastes should assist the cement plants for establishment of required facilities for utilization of waste. State Pollution Control Boards may consider incentives such as reduction of water cess or consent fee for such cement plants.

2 The use of Portland Pozzolana Cement (PPC) and Portland slag cement (PSC) should be encouraged in all public works.

Some government departments still have reservations about the use blended cement or the application of mineral admixtures in concrete, which could be sorted out through discussion.

3. Tax incentive should be provided for environment friendly blended cement production for conservation of limestone for future use. This will also serve the purpose of waste management and reduction in carbon emission as blended cement use environmentally hazardous materials like fly ash and slurry.

3. Rice husk ash (RHA) is a promising mineral admixture, for Indian conditions. The government may consider starting a 'RHA Mission' for its proper utilisation.

To cement manufacturers:

1. Limestone utilisation: Ensuring gainful utilisation of low and marginal grade limestone through application of appropriate technology.

2. Installation of waste heat recovery system shall be made compulsory for all new cement projects and proper studies shall be made to make it highly efficient by five stage pre-heater systems.

3 BEE conducts conferences and workshops on energy efficiency and advanced technologies. Companies could use such programs to train their employees for sustainable energy management. These employees could be further empowered by management to achieve higher performance through suitably designed key performance indicators (KPI).

4 R&D efforts are needed on a more vigorous basis, not only in the areas of resource conservation, energy and environmental management, waste utilization etc., but also in the focal areas like application of Nano-technology in cement and concrete, developing cements with lower clinker factors, exploiting newer cements such as composite cements and Portland limestone cements, assessment of service life and life cycle cost of structures, sequestration of CO₂ through carbon capture and storage etc. for reducing the carbon footprint of cement and construction industries.

4. Cement conies need to spend more on R&D for energy and water conservation, substituting costly and scarce raw material by alternate raw material and fuel, reducing clinker proportion in cement, carbon dioxide sequestration through capture and storage method, recycling of cement concrete in order to reduce carbon footprints of the cement industry and its ill effects on society and environment.

X. CONCLUSION

By analyzing and discussing the sustainability reports of top five cement companies in terms of sustainability challenges, their impacts and innovative measures and case studies towards mitigation of issues discussed in this paper, it can be

concluded that cement companies are well aware of impact of their operations on environment and society at large. Cement companies are addressing this issue seriously in their core as well as competitive strategies.

Energy and water conservation, resource optimization, carbon and GHG reduction, innovations for alternate raw material and fuel have now become integral part of business planning of cement companies. CSR- Hub score card (more than 60 for all cement companies in terms of environment aspect) depicts that cement industry has accepted environment challenges wholeheartedly and on path of environment sustainability through various innovative measures.

The National and Global compliance Standards are forging the environmental issues into the production line of cement with requirements for state of the art clean technologies, clean and green fuel and better monitoring and operation protocols. Cement Industries should appreciate the need and challenges for clean technologies and work beyond compliance requirement towards low carbon development to sustain its unprecedented growth in India.

REFERENCES

- [1]. Aggarwal Priyanka (2013). Impact of Sustainability Performance of Company on its Financial Performance. Global Journal of Management and Business Research Finance Volume 13 Issue 11 Version 1.0.
- [2]. Bapat J.d.(2012). Mineral Admixtures in Cement and Concrete. CRC Press, Taylor & Francis Group, Boca Raton, FL, USA.
- [3]. Bapat J.d.2013). Petcoke as Fuel for Cement Production: Benefits and Challenges. Cement Business & Industry (CBI) India & South Asia 2013, 9-10 October 2013.
- [4]. Bapat J.d. (2013). Cement Industry - Moving towards sustainable growth. Indian Cement Review, Vol. 28, No.4, Nov 2013 pp 61-63
- [5]. CSRHub, CSRHub Schema Description. Retrieved June 23, 2016, from <http://www.csrhub.com/content/csrhub-dataschema/>
- [6]. India Cement Review (2015) Clean and Green Cover Story, March 2015 issue.
- [7]. Mishra U.K., Tripathi A.K., Mishra Ajay, Mishra K., Dwivedi Rashmi (2013) Assessment of physico-chemical parameters of limestone mines water near J.P. cement plant Rewa District M.P. India. Journal of Engineering Science Invention ISSN (Online): 2319 – 6734, ISSN (Print): 2319 – 6726 www.ijesi.org Volume 2 Issue 7 1 July 2013 | PP.58-68
- [8]. Mishra Shradha, Dr.Nehal Anwar Siddiqui (2014). A Review On Environmental and Health Impacts Of Cement Manufacturing Emissions. International Journal of Geology, Agriculture and Environmental Sciences Volume – 2 Issues – 3 June 2014.
- [9]. Ministry of Water Resources, GOI (2011) Strategic Plan for Ministry of water Resources, new Delhi, February 2011.
- [10]. McKenzie report (2012) India: Taking on the green-growth challenge
- [11]. Nehru Kumar V (2013) Environmental decrees for cement industry. Indian Cement Review Apr 2013.
- [12]. Pahuja Neha, Pandey Nimisha, Mandal Koyel, Bandopadhyay Chayan (2014). GHG Mitigation In India: An Overview Of The Current Policy Landscape. IFMR working paper, March 2014, 1.
- [13]. Pathak Priyanka, Gupta Sumit, Dangayach Govind Sharan (2015). Sustainable Waste Management: A Case from Indian Cement Industry. Brazilian Journal of Operations & Production Management 12 (2015), pp 270-279

- [14]. Parlikar Ulhas (2013). From Grey to Green: Waste Co-processing in Cement Kilns. Cement Business & Industry (CBI) India & South Asia 2013, 9-10 October 2013, Mumbai, India
- [15]. Pralhad C.K.,Nidumolu Ram,Rangaswami M.R.(2009) Why Sustainability Is Now the Key Driver of Innovation.Harward Business Review, September 2009 issue.
- [16]. Rijsberman F.R.(2004) Water Scarcity: Fact or Fiction? International Water Management Institute, PO Box 2075, Colombo, Sri Lanka. www.iwmi.org,
- [17]. Sarda Rajesh (2013). Indian Cement Sector Outlook. Cement Business & Industry (CBI) India & South Asia 2013, 9-10 October 2013, Mumbai, India
- [18]. Viswanathan A.(2012) Emerging trends & challenges in Indian cement industry. Indian Cement Review Journal, August 2012.
- [19]. World Business council for Sustainable Development & International EnergyAgency(2009). Cement Technology Roadmap 2009, Carbon emissions reductions up to 2050
- [20]. Yadav Rajendra Kumar (2015) .There is huge scope for older plants to modernise and optimise processes. Indian Cement Review, March 2015