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**GREEN MANUFACTURING HELPS TO CONTROL GLOBAL WARMING: - A
CRITICAL REVIEW**

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ABSTRACT

In this paper we are approaching to the effect of using Green manufacturing in the Global Warming. The main causes for energy inefficiency and environmental pollution are increased plant capacity and introduction of new factories, outdated production technology in use, aged industrial infrastructures, lack of management skills and coal dominated energy structures. Therefore, there is a need for an integrated approach like Green Manufacturing technology towards energy and environment management of the industry so that better energy efficiency and environmental friendliness can be achieved.

This research work provides information on control techniques and measures that are available and adopted by steel industries to moderate greenhouse gas (GHG) emissions, global warming, reduced CO₂ emission, describes the process technology in use, energy saving opportunities, Environmental benefits of recycling & Sustainable development related to the iron and steel manufacturing sector through green manufacturing technology. We introduce the Indian iron and steel industry in more detail taking into account industry, production, technologies, energy consumption within processes, environmental impacts of steel recycling etc.

KEYWORDS: Green Manufacturing, CO₂ emission, Human Comfort, Environmental friendly.

INTRODUCTION

India continues to remain the 4th largest producer of crude steel in the world as against the 8th position in 2003 and is expected to become the 2nd largest producer of crude steel soon. (Crude steel production grew at 8% annually [Compounded Annual Growth Rate (CAGR)] from 46.46 million tonnes in 2005-06 to 81.2 million tonnes in 2012-13) and it is the largest producer of direct reduced iron (DRI) or sponge iron in the world with the coal based route accounting for 76% of total sponge iron production in the country (20.37 mt in 2011-12; prov.) (<http://steel.gov.in/overview>). The production of steel accounts for approximately 5% of total CO₂ emissions. It is the largest industrial emitter and a prime focus for governments. Steel industry is one of the biggest industries of resource consumption and pollution emission (Iron and Steel Industry in India, 2012). Relevant data show that, in iron industry, the total energy consumption amounts to 14.71%. In the past five years, the comprehensive energy consumption per ton of iron has reduced by 179 kgce/t, but there is still a large gap to achieve the level in

developed countries that is between 12% and 15 percent. Corporate social responsibility for Iron Industry should contain the duty for environmental protection, resources protection and rational utilization. As the basic industry of national economy, iron industry must bear both economic responsibility and social responsibility. Traditional manufacturing mode that practicing in iron industry of India is one important factor that caused above problems. Green manufacturing mode is developed in recent years. Some researches show that two advantages of practicing green manufacturing can be presented. On one hand, sustainable development strategy could be guaranteed. On the other hand, considerable economic benefits could be gained for enterprises. The cycle of “material—production—flotsam—material” can be constructed in industry enterprises with saving energy, reducing loss and reducing pollution). If green manufacturing can be put into practice successfully, the contradiction between environmental pollution and sustainable development will be effectively solved. So it is feasible and necessary for iron industry in India to adopt the green manufacturing mode[2].

The motivation for adopting Green manufacturing has varied across sectors. Some take it up owing to regulatory compulsions (example: power), while others see it as an opportunity to build a stronger brand with consumers (example: retail). Steel manufacturers have adopted Green initiatives to stabilise rising energy costs, while automobile companies have seen it as an opportunity to launch electric and hybrid cars to meet increasingly stringent emission regulations. The impact of Green initiatives also varies by the industry sector. For example, Green initiatives in the power sector have the maximum impact on reducing CO₂ emissions followed by transportation and then the industrial sector [3].

Steel industry is complex and highly pollution concentrated. Way ahead, the sector is growing quickly, so at every stage of steel making, better efficiency and pollution control is to be expected. Steel is also a mature basic material and is one of the most environmentally gentle mass products due to its high recycling rate and comparatively low quantities of energy required for its making. However, the emission of CO₂ is a serious problem for steel industry because steel industry relies greatly on fossil fuels as energy source and limestone for the purification of iron oxides. Steel industry contributes around 6% - 7% to total anthropogenic emission of CO₂. Steel works now face with the increasing demand to minimize emission of GHGs [4].

Since the country's growth is necessary, its environmental concerns can be moderate in the manufacturing sector by using energy and resources efficiently, and minimize generation of waste. It is estimated that even if every factory, power plant, car and aero plane is shut down, the average global temperature would still increase by 0.6°C in this century. 'Green Manufacturing' or sustainable industrial activity is now the need of the hour and no more an empty slogan. Therefore, there is a need for an integrated approach like green manufacturing technology towards energy and environment management of the industry so that better energy efficiency and environmental friendliness can be achieved. Implementation of green manufacturing can

be the desired approach. Green manufacturing is a combination of control techniques which are available to mitigate greenhouse gas (GHG) emissions, describes the process technology in use, energy saving opportunities, Environmental benefits of recycling & Sustainable development related to the iron and steel manufacturing sector through green manufacturing technology.

LITERATURE REVIEW

Sathees Kumar Kesavan., et, al., say that the proton exchange membrane fuel cells (PEMFCs) are the most preferred and efficient energy conversion devices for automotive applications but demand high purity hydrogen which comes at a premium price. The currently pursued hydrogen generation methods suffer from issues such as, low efficiency, high cost, environmental non-benignity, and, in some cases, commercial non-viability. Many of these drawbacks can be overcome by resorting to metal-steam reforming using iron from steel industry's mill-scale waste. A novel solution-based room temperature technique using sodium borohydride (NaBH₄) as the reducing agent has been developed that produces highly active nano scale (30–40 nm) iron particles. A slightly modified version of this technique using a surfactant and water-oil micro emulsion resulted in the formation of 5 nm spherical Fe particles. By using hydrazine as an inexpensive and more stable (compared to NaBH₄) reductant, body centered cubic iron particles with edge dimensions 5 nm were obtained under mild solvo thermal conditions in ethanol. The nano scale zero valent iron (nZVI) powder showed improved kinetics and greater propensity for hydrogen generation [1].

MATERIAL EFFICIENCY INDICATOR

World steel members report that 94-98% of the raw materials used to make crude steel are converted to products (crude steel) and by-products – based on total output material (i.e. crude steel, byproducts and waste), meaning that very little waste goes to incineration or landfill (see figure below). The industry's goal is zero waste.

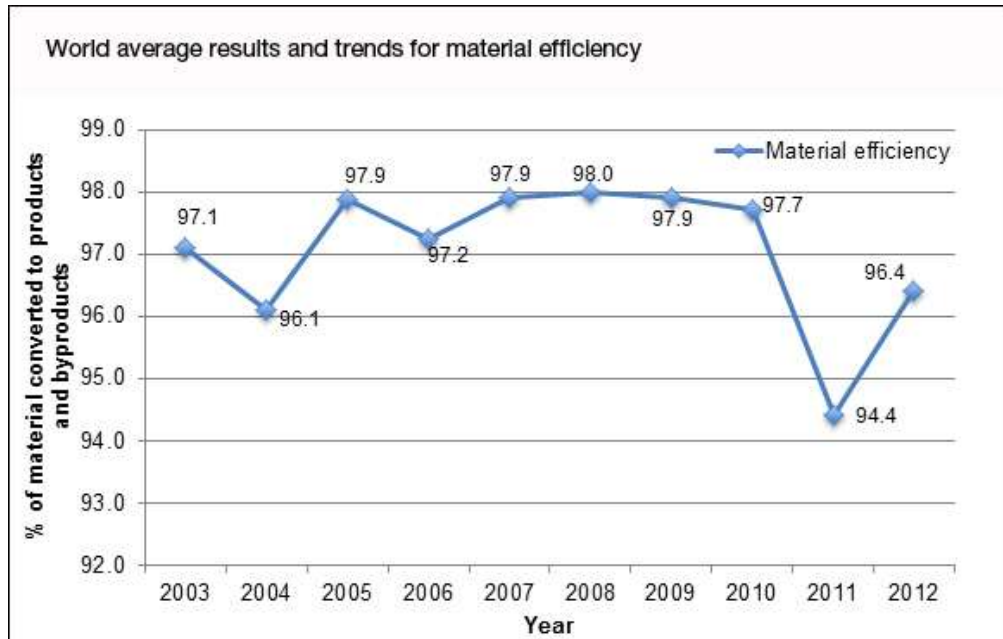


Table 1:- The number of companies reporting on material efficiency has increased over the years.

WORLD STEEL PRODUCTION

According to world steel association, World crude steel production reached 1,607 megatonnes (Mt) for the year 2013, up by 3.5% compared to 2012. The growth came mainly from Asia and Middle East while crude steel production in all other regions decreased in 2013 compared to 2012. Annual production for Asia was 1,080.9Mt of crude steel in 2013, an increase of 6.0% compared to 2012. The region’s share of world steel production increased slightly from 65.7% in 2012 to 67.3% in 2013. China’s crude steel production in 2013 reached 779.0 Mt, an increase of 7.5% on 2012. China’s share of world crude steel production increased from 46.7% in 2012 to 48.5% in 2013. Japan produced 110.6 Mt in 2013, a 3.1% increase from 2012. South Korea’s crude steel production was 66.0 Mt, a decrease of -4.4% compared to 2012.

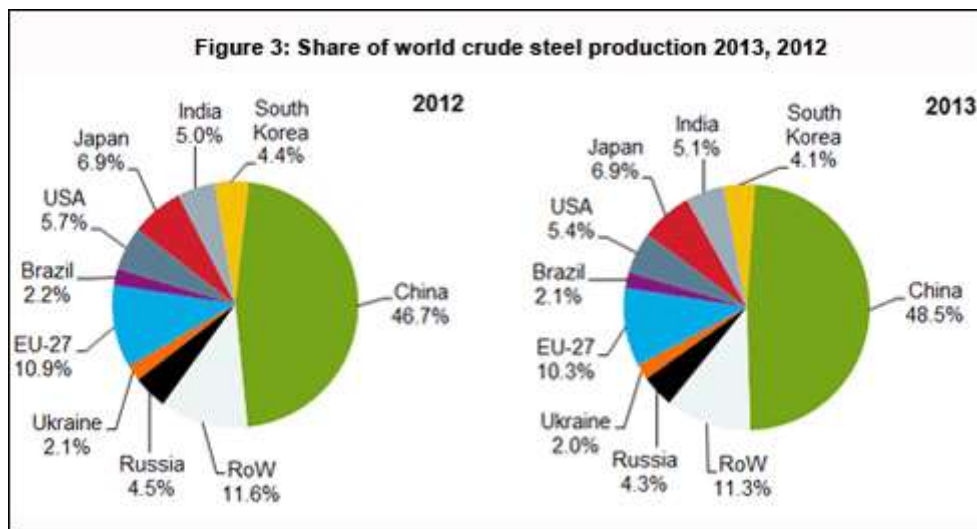
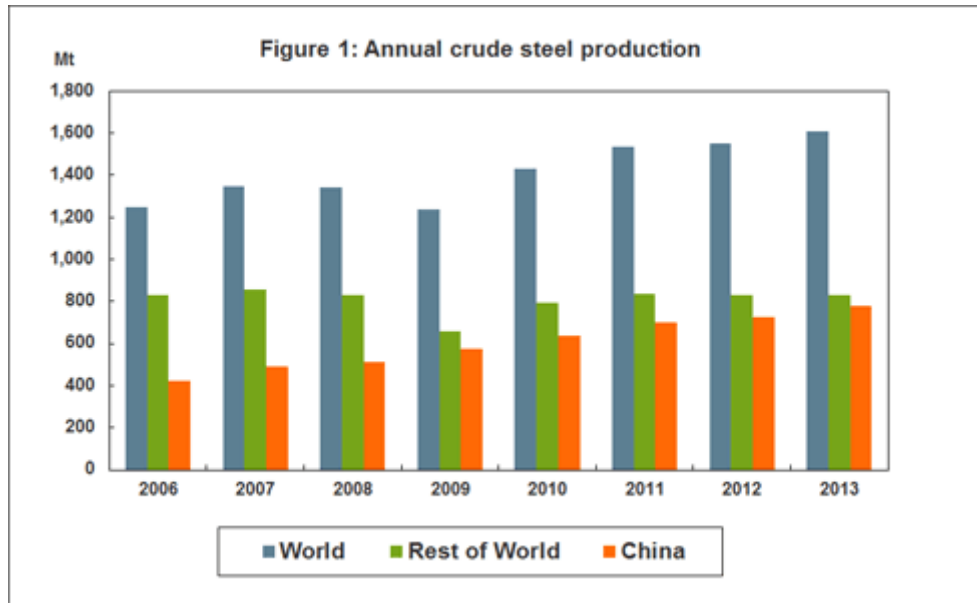
The EU recorded a decrease of -1.8% compared to 2012, producing 165.6 Mt of crude steel in 2013. Germany produced 42.6 Mt of crude steel in 2013,

remaining at the same production level as 2012. Italy produced 24.1 Mt in 2013, a -11.7% decrease over 2012. France’s crude steel production in 2013 was 15.7 Mt, an increase of 0.5%. Spain produced 13.7 Mt of crude steel in 2013, a 0.7% increase on 2012.

In 2013, crude steel production in North America was 119.3 Mt, a decrease of -1.9% on 2012. The US produced 87.0 Mt of crude steel, down by -2.0% compared to 2012.

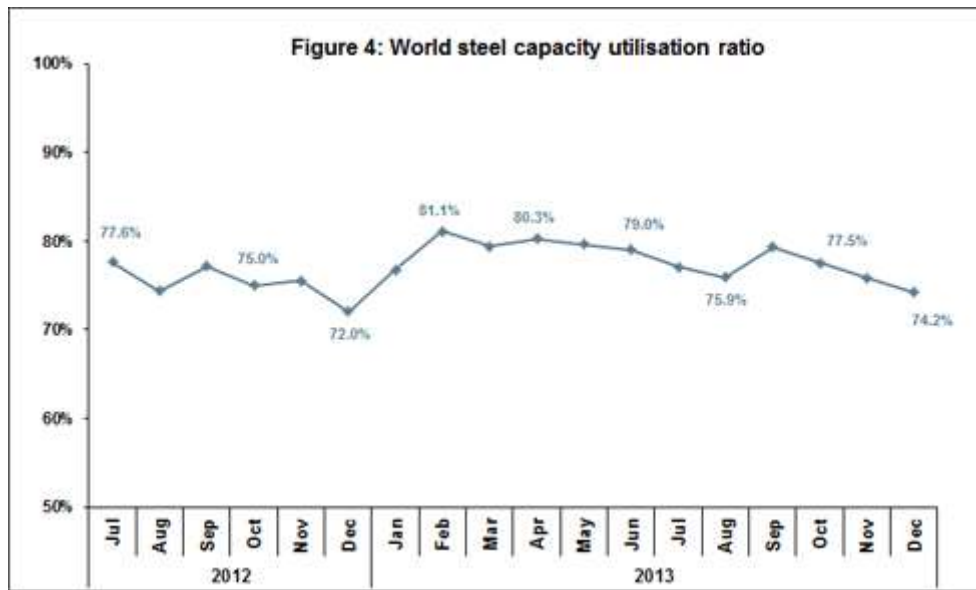
The CIS showed a decrease of -1.8% in 2013, producing 108.9 Mt of crude steel. Russia produced 69.4 Mt of crude steel, a decrease of -1.5% on 2012 and Ukraine recorded a decrease of -0.5% with a year-end figure of 32.8 Mt.

Annual crude steel production for South America was 46.0 Mt in 2013, a decrease of -0.8% on 2012. Brazil produced 34.2 Mt in 2013, down by -1.0% compared to 2012.



In December 2013, world crude steel production for the 65 countries reporting to the World Steel Association (worldsteel) was 129.2Mt, an increase of 6.3% compared to December 2012. The crude steel

capacity utilisation ratio of the 65 countries in December 2013 declined to 74.2% from 75.8% in November 2013. It is 2.2 percentage points higher than December 2012. The average capacity utilisation in 2013 was 78.1% compared to 76.2% in 2012.



The World Steel Association (worldsteel) released its Short Range Outlook (SRO) for 2014 and 2015. worldsteel forecasts that global apparent steel use will increase by 3.1% to 1,527 Mt in 2014 following growth of 3.6% in 2013. In 2015, it is forecast that world steel demand will grow further by 3.3% and will reach 1,576 Mt.

China remained the world's largest crude steel producer in 2013 (779 mt) followed by Japan (110.6 mt), the USA (87 mt) and India (81.2 mt) at the 4th position (72.2 mt).

In India, steel demand is expected to grow by 3.3% to 76.2 Mt in 2014, following 1.8% growth in 2013, due to an improved outlook for the construction and manufacturing sectors, even though this will be constrained by high inflation and structural problems. Despite uncertainties relating to the impact of upcoming elections steel demand is projected to grow by 4.5% in 2015 supported by the expectation that structural reforms will be implemented.

RESULT/ DISCUSSION

India is currently the fourth largest producer of crude steel in the world and is expected to become the second largest in the near future. The total market value of the Indian steel sector stood at US\$ 57.8 billion in 2011 and is predicted to touch US\$ 95.3 billion by 2016. The sector contributes to nearly 2 per cent of the gross domestic product (GDP) and employs over 500,000 people.

Being a core sector, the steel industry reflects the overall growth of an economy in the long term. The demand for steel is also derived from other sectors such as automobiles, consumer durables and infrastructure. The Indian steel sector enjoys advantages of domestic availability of raw materials and inexpensive labour. Iron ore is also available in abundant quantities, providing a major cost advantage to the domestic steel industry.

The liberalisation of industrial policy and other initiatives taken by the Government of India have given a definite impetus for entry, participation and growth of the private sector in the steel industry. While the existing units are being modernised or expanded, a large number of new steel plants have also come up in different parts of the country based on modern, cost-effective, state-of-the-art technologies.

India's real consumption of total finished steel stood at 53.789 million tonnes (MT) during April–December, 2013. Production for sale of the finished steel was 60.446 MT, registering a growth of 5.2 per cent during the period owing majorly to growth in production by major producers such as Steel Authority of India Ltd (SAIL), Tata Steel and Rashtriya Ispat Nigam Ltd (RINL).

Total steel production in India recorded a growth rate of 3.5 per cent during the period October 2012–October 2013. "Production of steel in India is expected to reach 149 MT by the end of the 12th Five Year Plan period," as per Shri G Mohan Kumar, Secretary, Ministry of Steel.

India's iron ore pellet exports have grown by almost 11 times to 435,000 tonnes during April–October 2013–14, as compared to 40,000 tonnes exported in 2012–13. The industry expects the total exports of pellets during the current financial year to touch a level of 800,000 tonnes. At present, 36 pellet plants are operating in India, with a combined capacity of 63 million tonnes per annum (MTPA). Total expected capacity expansion and new plants together will add another 72 MT capacity by 2016–17.

PRODUCTION, CONSUMPTION AND GROWTH OF STEEL

Today, India is the 4th largest crude steel producer of steel in the world. Crude steel production has shown a sustained rise since 2007-08 along with capacity. Data on crude steel production, capacity and capacity utilization during the last five years and April-December 2012-13, are given in the table below:

In 2011-12 (prov), production for sale of total finished steel (alloy + non alloy) was 73.42 mt.

Production for sale of Pig Iron in 2011-12 (prov), was 5.78 mt.

India is the largest producer of sponge iron in the world with the coal based route accounting for 76% of total sponge iron production in the country (20.37 mt in 2011-12; prov.):

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