



A STUDY ON POST COVID IMPACT ON ENVIRONMENT SUSTAINABILITY OF MANUFACTURING INDUSTRIES IN KERALA

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Abstract: Study relates with the identification on the factors relating to the environment impact of manufacturing relating to post covid 19. This study focus on identifying the potential environment issues relating to manufacturing, action plan to mitigate the issues, potential strategies for implementation to overcome to issues. The study also focus on measurement of environmental parameters different types of pollution contributing by manufacturing industries having concern on environment as well as Indian economy. This study also focus on modeling of environmental issues and their control measures relating to operation relating industries in kerala post covid19.

Industrial safety / Environmental Protocol to ensure the environmental sustainability of the business after the startup of the manufacturing industry after covid 19 for submission to regulatory bodies to avoid environmental/ safety incidents plays a major role in reducing environment incidents in Kerala .

Keywords: Environment sustainability, industrial hazards, solid waste management, Green recovery, carbon foot print reduction

1. Introduction

Many industrial hazards were reported from different industries with the starting of an lockdown phase leading to poor safety and sanitation protocols are forcing us to define new strategy for their better conservation and management. In post Covid 19 era ,we need to redefine, reform and re enforce policies, technologies ,waste management and handling of waste inventory and its disposal and safety protocols with better perspective.

Regulatory bodies imposing a start up procedure after lock down and submission of report on start up for all industries to avoid safety accidents, environment hazards and incidents and effective disposal of solid waste as per the protocol The worldwide disturbance caused by the COVID19 pandemic leading to industrial activities have caused many regions to experience a huge drop in air, water, noise pollution.

Issues relating to environment sustainability in manufacturing industries includes limited physical interactions between company employees and client contractors, difficulties in Site access, Difficulty in ensuring solid waste management during and post COVID-19 Pandemic, 3R strategy on sustainability (Reduce ,Reuse and Recycle) strategy cannot be continued in post covid era in industries

Due to improper shut down activities associated with stoppage in industries, by products from the process generation is high and its short term expiry affect the process at the time of start up . There is increased waste and reduction in waste recycling of business cannot continue wrt waste management during this pandemic and necessity of proper disposal of Personal Protective Equipment (PPE) has increased

Appropriate monitoring, review and verification mechanisms has become necessity for Common Biomedical Waste treatment facilities in industry. Sustainable practices and environmental policies can help societies fulfill their needs and aspirations in the post-COVID19 era by helping the economic recovery onto a more sustainable and resilient track. In the post crises scenario, the Endeavour should be to create better opportunities for green investments while adhering to the standards of sustainable production and consumption leading to building a green industrial community in the organization.

Plastic waste by segment, is increasing in the trend of medical, food packaging, and other plastic waste associated with Covid ...Approaches for ensuring Environment sustainability in post COvid 19 includes effective Bio-medical waste management during and post COVID-19 pandemic, Green recovery could be assisted by reducing environment impact in manufacturing industries such as converting waste to wealth, Converting byproducts to useful wealth, 'Implementation of condensate recovery system in process, Use of eco friendly fuel for steam generation such as LNG,CNG etc, Implementation of carbon reduction programmes Other wind and solar for independent electricity provision for industries making them more independent,, light through green building shall make employees e more healthy and stress free, overall monitoring and sampling time spent is more resulting in grouping of people together for longer duration, Frequent sterilization of the testing equipments used for monitoring and testing, Frequent sanitization of the work place and installation of automatic hand Sanitizers .Application of sophisticated instrument with digital data logging, software modeling helps to monitor environmental parameters, Application of testing kits will reduce no. of workers required for conducting activities.

Opportunities are arising to learn new skills in new areas such as remote and continuous monitoring of environmental parameters along with their analysis.

As the COVID-19 crisis continues many global industrial products companies are facing challenging times including production stoppages, due to supply chain disruption, cost escalation and workforce dislocation results in environmental degradation

2. Environmental Sustainability wrt control of pollution in post covid era includes

2.1. Reduction of water pollution

Water pollution is a common phenomenon of a developing country like India, where domestic and industrial wastes are dumped into rivers without treatment During the lockdown period, the major industrial sources of pollution have shrunk or completely stopped because of stoppage of ETP which helped to reduce the pollution load.

However, the amount of industrial water consumption is also reduced, especially from the textile sector in India

Usually, huge amount of solid trashes is generated from construction and manufacturing process responsible for water and soil pollution, also reduced

2.2. Reduction of noise pollution

Noise pollution is the elevated levels of sound, generated from different human activities (e.g., machines, vehicles, construction work), which may lead to adverse effects in human and other living organisms. Usually, noise negatively effects on physiological health, along with cardiovascular disorders, hypertension, and sleep shortness of human.

However, the quarantine and lockdown measures mandate that people stay at home and reduced economic activities and communication worldwide, which ultimately reduced noise level in most cities

2.3. Increase of biomedical waste generation

Since the outbreak of COVID-19, medical waste generation is increased globally, which is a major threat to public health and environment.

For sample collection of the suspected COVID-19 patients, diagnosis, treatment of huge number of patients, and disinfection purpose lots of infectious and biomedical wastes are generated from hospitals and industries. Such a sudden rise of hazardous waste, and their proper management has become a significant challenge to the local waste management authorities.

So, waste generated from the hospitals and health care manufacturing industries (e.g., needles, syringes, bandage, mask, gloves, used tissue, and discarded medicines etc.) should be managed properly, to reduce further infection and environmental pollution, which is now a matter of concern globally.

2.4. Safety equipment use and haphazard disposal

To protect from the viral infection, presently peoples are using face mask, hand gloves and other safety equipment, which increase the amount of healthcare waste.

It is reported that, in India , trash amount has been increasing due to increased PPE use at the domestic level. Since the outbreak of COVID-19, the production and use of plastic based PPE is increased worldwide..

However, due to lack of knowledge about infectious waste management, most people dump these (e.g., face mask, hand gloves etc.) in open places and in some cases with household wastes. Such haphazard dumping of these

trashes creates clogging in water ways and worsens environmental pollution

It is reported that, face mask and other plastic based protective equipment are the potential source of micro plastic fibers in the environment. Usually, Polypropylene is used to make N-95 masks, and Tyvek for protective suits, gloves, and medical face shields, which can persist for a long time and release dioxin and toxic elements to the environment

Though, experts and responsible authorities suggest for the proper disposal and segregation of household organic waste and plastic based protective equipment (hazardous medical waste), but mixing up these wastes increases the risk of disease transmission, and exposure to the virus of waste workers).

Disposal method includes open burning, Incineration in Waste burning plant, Pyrolysis, Thermal combustion etc without polluting the environment with increased stack height and analysis of flue gas on an intermittent basis.

2.5. Municipal solid waste generation, and reduction of recycling

Increase of municipal waste (both organic and inorganic) generation has direct and indirect effects on environment like air, water and soil pollution.

Due to the pandemic, quarantine policies established in many states have led to an increase in the demand of online shopping for home delivery, which ultimately increase the amount of household wastes from shipped package materials.

However, waste recycling is an effective way to prevent pollution, save energy, and conserve natural resources. But, due to the pandemic many states in India postponed the waste recycling activities to reduce the transmission of viral infection.

Overall, due to disruption of routine municipal waste management, waste recovery and recycling activities, increasing the land filling and environmental pollutants worldwide

It is assumed that, all of these environmental consequences are short-term. So, it is high time to make a proper strategy for long-term benefit, as well as sustainable environmental management. The COVID-19 pandemic has elicited a global response and make us united to win against the virus.

3.0 Research Methodology

3.1 Objectives of the study

1. To assess the effect of various environmental parameters wrt emissions, pollution and solid waste management generated by industries on account of covid 19 in Kerala
2. To study the effectiveness of 3R strategy on sustainability wrt industries in Kerala
3. To study the effectiveness of Environmental safety protocol submitted by industries in Kerala during start up of manufacturing industries after unplanned stoppage due to covid pandemic

Sample size: population includes 20 manufacturing industries of large scale nature in kerala in Trivandrum ,kollam and Kochi and out of which 15 sample industries are selected for industry

Sampling Technique used: Stratified random sampling

Sources of data: Primary data is collected by sending questionnaires to the industries .Respondents includes Officials from Safety &Environment Dept

Secondary data is collected with the help of KSPCB reports on Environmental parameters associated with Covid 19 and Post covid 19

Statistical Tools used for study: Ztest, CHI Square, Karl Pearsons Coefficient of Correlation ,Annova

Null Hypothesis: H01: There is no significant difference in Environmental parameters due to covid parameters in associated with industrial operations

Alternate Hypothesis H11: There is significant difference in Environmental parameters due to covid parameters in associated with industrial operations

Null Hypothesis H02: Effectiveness in 3R strategy in industries due to Covid 19 found not effective on evaluation

Alternate Hypothesis H12: Effectiveness in 3R strategy in industries due to Covid 19 found effective on evaluation

Karl Pearson coefficient of correlation is used to study the relationship between environmental incidents during the start up after Covid 19 and the environmental protocol devised as suggested by the regulatory bodies

H03: There is no significance difference in the occurrence of environment safety incidents by the implementation of safety/Environment protocol by the industries before start of operations after Covid Pandemic

H13: There is significance difference in the occurrence of environment safety incidents by the implementation of safety/Environment protocol by the industries before start of operations after Covid Pandemic

4.0 Findings based on the research studies relating to Environmental sustainability

Based on the environment parameters monitored reported 46 per cent reduction in PM2.5 levels and 50 per cent depletion in PM10 concentrations in the industries in Kochi

71% drop in NO2 levels is observed In the industries of Trivandrum while Kochi observed a 62% drop as per the KSPCB data

It was also stated that, the levels of NO2 and PM2.5 reduced by almost 70% in industries in Trivandrum the capital of Kerala .Overall, 46% and 50% reduction of PM2.5 and PM10 respectively, was reported in industries in Kerala during the nationwide lockdown.

It is observed that, coal-based power generation reduced 26% in India with 19% reduction of total power generation after lockdown in power plants in Kerala

It is found that, among the 36 real-time monitoring stations of river Periyar water from 27 stations met the permissible limit

This improvement of water quality at Pamba at Sabarimala was ascribed to the sudden drop of the number of visitors and 500% reduction of sewage and industrial effluents

According to the real-time water quality monitoring data of the Kerala state Pollution Control of India, physicochemical parameters based on industrial effluent analysis i.e, pH (7.4–7.8), dissolved oxygen (DO) (9.4–10.6 mg/L), biochemical oxygen demand (BOD) (0.6–1.2 mg/L) and total coliform (40–90 MPN/100 mL) of the river Periyar in Kochi was found within the surface water quality standard of India

The results of Null Hypothesis reveals that H11 is accepted .There is significant difference in environmental parameters in manufacturing industries in connection with Covid 19(chi square distribution)

The results of Null Hypothesis show H02 is true. The effectiveness of 3R strategy in connection with industrial waste management associated with COVID found not effective on evaluation due to increased usage of plastic associated with covid and waste disposal system not being adhered properly in industries (ANOVA test)

The results in the null hypothesis shows H03 is false. The occurrence of environment safety incidents by the implementation of safety/Environment protocol followed by the industries based on the statutes recommended by regulatory bodies before start of operations after Covid Pandemic found effective.

There was a significant reduction (40% reduction) in environmental related incidents by the implementation of safety/Environment protocols. The same has been established by means of adapting Karles Pearson coefficient of correlation which establishes negative correlation between environment incidents and implementation of safety/Environmental protocols during start up of industries after Covid 19

5.0 strategies proposed for global environmental sustainability (Suggestions)

5.1 Sustainable industrialization

Industrialization is crucial for economic growth; however, it's time to think about sustainability. For sustainable industrialization, it is essential to shift to less energy-intensive industries, use of cleaner fuels and technologies, and strong energy efficient policies, use of ecofriendly raw materials, advanced waste recycling programmes, waste segregation at source ,following best biomedical practices in the industry

Moreover, industries should be built in some specific zones, keeping in mind that waste from one industry can be used as raw materials of the other. After a certain period, industrial zones should have been shut down in a circular way to reduce emission without hampering the national economy. Again, industries especially where a huge number of people work, proper distance and hygienic environment should maintain to reduce the spread of any infectious communicable disease.

5.2 Use of green and public transport:

To reduce emissions, it is necessary to encourage employees in industries to use public transport, rather private vehicles or company owned shared transportation

Besides, people should encourage to use bicycle in a short distance, and public bike sharing (PBS) system should be available for mass usage, which is not only environment friendly but also beneficial for health

5.3 Use of renewable energy:

Use of renewable energy can lower the demand of fossil fuels like coal, oil, and natural gas, which can play an important role in reducing the GHGs emissions. Due to the COVID-19 pandemic, global energy demand is reduced, which results in the reduction of emission and increased ambient air quality in many areas. But, to maintain the daily needs and global economic growth, it is not possible to cut-off energy demand like a pandemic situation.

Hence, use of renewable energy sources like solar, wind, hydropower, geothermal heat and biomass can meet the energy demand and reduces the GHGs emission. Also energy efficient manufacturing systems, Energy audit to be conducted by implemented to reduce the energy consumption and energy base line indicators including significant energy sources to be identified and energy reduction programmes in industries to be institutionalized

5.4 Industrial Wastewater treatment and reuse:

To control the challenges of water pollution, industrial wastewater should be properly treated before discharge.

Besides, reuse of treated wastewater in non-production processes like toilet flushing and road cleaning can reduce the burden of excess water withdrawal.

5.5 Waste recycling and reuse:

To reduce the burden of wastes and environmental pollution, both industrial and municipal wastes should be recycled and reused. Techniques such as Ultra filtration, Reverse Osmosis help to recycle the treated water for process applications. Hence, circular economy or circularity systems should implement in the production process to minimize the use of raw material and waste

generation. Moreover, hazardous and infectious medical waste should be properly managed by following the Hazardous waste management and Handling rules 2019

So, government should implement extensive awareness campaign through different mass media, regarding the proper waste segregation, handling and disposal methods.

5.6 Behavioral change in daily life:

To reduce the carbon footprint and global carbon emission, it is necessary to change the behavior in our daily life and optimum consumption of resources like; avoid processed and take locally grown food, make compost from food waste, switch off or unplug electronic devices when not used, and use a bicycle instead of a car for short(er) distances.

5.7 International cooperation:

To meet the sustainable environmental goals and protection of global environmental resources, such as the global climate and biological diversity, combined international effort is essential. Responsible international authority like United Nations Environment Programme (UN Environment) should take effective role to prepare time-oriented policies, arrange international conventions, and coordination of global leaders for proper implementation in industries.

Implementation of ISO 14001: and ISO 50001 management systems to ensure adherence to Environment Management standards and Energy Management standards

Directly or indirectly, the pandemic is affecting human life and the global economy, which is ultimately affecting the sustainability of industries. It reminds us how we have neglected the environmental components and enforced human induced climate change.

Moreover, the global response of COVID-19 also teaches us to work together to combat against the threat to mankind in industry.

Though the impacts of COVID-19 on the industrial environment are short-term, united and proposed time-oriented effort can strengthen environmental sustainability and save the mother earth

. It is also found that, the concentration of pH, electric conductivity (EC), DO, BOD and chemical oxygen demand (COD) has reduced almost 1–10%, 33–66%, 45–90%, and 33–82% respectively in different monitoring stations during the lockdown in comparison to the pre-lockdown period

Water pollution are also reduced in the various beach areas of I Kerala reported that, due to the COVID-19 lockdown,

the amount of food waste is reduced in Kerala which ultimately reduces soil and water pollution.

According to the Central Pollution Control Board (CPCB, 2021) of Kerala, noise level of manufacturing area of Kerala is reduced 55 dB (daytime) and 45 dB (night) to 40 dB (daytime) and 30 dB (night) respectively

For instance Kerala produced more than 100 metric tons of medical wastes every day during the time of the outbreak, which is almost 80 metric tonnes higher than the normal time

3. Conclusion

The impact of Post covid impact on Environment sustainability of manufacturing industries can be compensated by better technologies for waste reduction, emphasis on modern approach on waste recycling programmes, ensuring hygienic practices including GMP, compliance, effective usage of renewable energy sources and by adaptation of pollution mitigation strategies. Amendment of 3R strategies and its review at defined frequencies during safety/Environment review meetings of industries helps for efficient recycling of wastes. Ensuring 100% compliance through monitoring of safety/environment protocols relating to start up of industries associated to planned/unplanned stoppages in connection with Covid helps to eliminate environment incidents. Also environment mock drills should be conducted by industries to ensure zero environment incidents

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