ABSTRACT

In the second technology day address of 2000, His Excellency Professor Murali Manohar Joshi gives a new paradigm to sustainable development. He defines sustainable consumption as something to deal with use of products and services that respond to bring a better quality of life. This must be achieved by minimizing the uses of emissions, waste and pollutants over the life cycle of any process where commodity is made. This inadvertently thus leads to clean technology. He states that a re evaluation of the goals, strategies and tactics for sustainable consumption by focussing on five critical areas.

1. Human ethics.
2. Life styles.
4. Community and Patterns.
5. Equity.

Taking this as a cue, this research is focussing on achievement of sustainable development which spontaneously leads to sustainable consumption. In this research investigation, LCA as a tool is used for achieving this purpose. All aspects of LCA, including paradigm shift for better strategies, Eco design, Eco labeling, ISO system, TQM and ethics are all brought out. LCA, as a futuristic tool, is also cited.

To quantitatively achieve the LCA, both qualitative and quantitative approaches are extracted from preplanned questionnaire, sent to cluster of companies. The qualitative aspects on worker safety, impact assessment, LCA and EIA are all appended as possible scenario applicable in general.
The quantification approach has been attempted for both - the cluster companies, based on the feedback to questionnaire and also from literature research information on runoff, emits etc., The scenario development of waste quantification with LCA as a tool is approached on the following lines.

When the data does not require any treatment base, as the limits are within bio-compatible ones, the data homogenization and validation has been attempted using simple statistics. Like this, the matrix based equation for the regression plane has been arrived at

\[ Y (\text{CH}_4 \text{ gas}) = 3969 - 3.82 X_1 (\text{BOD}) + 18.30 X_2 (\text{COD}) \].

The product moment correlation coefficient and the rank correlation coefficient have also been arrived at, for mixed data. The coefficient has been found to be 1 which validates the data.

The confidence interval for COD from cluster companies and research data has been estimated. The exercise indicates that the range falls within the data range. This has been repeated for thermo-dynamic efficiency and the same outcome has been observed. The regression line and correlation coefficient for the above have been arrived at, as follows.

\[
\begin{align*}
Y (\text{CH}_4) &= 33.93 X (\text{COD}) + 163074 \\
X (\text{COD}) &= 0.013 Y (\text{CH}_4) + 20598
\end{align*}
\]

and correlation coefficient is 0.66.

In continuation of the above, the application of LCA for polymer waste to VAP, has been done in a systematic way, using experimental data based on research. The Catalyst activity equation for degradation of polymer is also given as \( \alpha = \alpha_0 (1 - 0.15t) \).

As part of clean technology requirement in the study of holistic sustainability, a clean technology initiative was defined and the clean technology
initiative has been arrived at for recycling of carbon, from the cluster companies data with the follow up of clean technology index. Initially, apriori the data validation approach using one way ANOVA was arrived at for significant polluting industry data. The treated effluent were within bio compatible limits and hence, paradigm shifting and CTI could be put to with cluster of Company data. The clean technology initiative as expected, augmented with COD a vital parameter for environmental concern.

As a next academic strategy, Bhopal Scenario was modelled for clean technology based on Kalinin Charnobyl model & the GNP equation arrived at for various realistic scenarios and all these are appended. The equation for GNP is

\[
\frac{\Delta \text{GNP}}{\text{GNP}} = \frac{3.322}{\text{HR}} + \frac{1.215}{\text{NR}} + \frac{26.675}{\text{EC}}
\]

In continuation of the research requirement, paradigm shift based on Socio Techno and Eco centricities for the company cluster data and the outcome are arrived at. The following equations are given for such centricities.

Techno Centricity \[
Y(\text{COD}) = 1.6 \times 10^{-4} X(\text{CTI}) + 152.42
\]
Socio Centricity \[
Y(\text{eff}^* R) = -2.31 \times 10^{-7} X(\text{CTI}) + 0.1
\]
Eco Centricity \[
Y(\text{eff}') = 3.37 \times 10^{-7} X(\text{CTI}) + 0.77
\]

Further to this, the risk assessment of chloroform in water for probable cancer deaths are calculated as an example. Carcinogenic polymer with plasticizers and their conversion to protein (Biomass) or Biogas have been economically assessed. It is found that the biomass is much better with good return on investment than biogas.
Based on the understanding evolved from all the above quantified approaches a discussion on the holistic sustainable development involving all the sensitive parameters of the companies and research data are attempted. Paradigm shift in clean technologies are also appended. Monte Carlo approach for the costing and financial risk assessment in ecologization in phenol water detoxified with health angle is projected. Monte Carlo approach for financial risk and costing is also given for the cluster of six companies.

The performance of company from the cluster of companies feedback data had been comprehensively evaluated for Eco negativity or Eco positivity besides strategies for converting CH$_3$OH based on research data is also appended as scenario.

With the understanding evolved on the use of LCA for quantification of waste, sustainable development is brought out as an important aspect for future of any industrial based management practices.