

Zero Impact Manufacturing Initiative (ZIMI): A Strategic Approach Towards Voluntary Risk Elimination in Chemicals Management

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Zero Impact Manufacturing Initiative (ZIMI) is a strategic movement launched by the Cleantech International Foundation for rapid transformation of enterprises to minimize their impact on global environment through eco-efficient production aiming at zero input of freshwater, energy and prime or non-renewable materials coupled with zero emission. ZIMI involves extensive process re-engineering based upon cost effective innovation and recourse to alternative materials and processes for total risk elimination.

In order to implement ZIMI at shop floor level, extensive plant level process analysis are carried out with a view to identify opportunities to reduce the intake of freshwater, energy and non renewable materials so as to minimize the impact of enterprises on natural resources through demand side management. Use of prime materials is avoided by taking recourse to total recycling and mining the dumps while toxic and hazardous materials and processes are skillfully substituted using benign alternative. Extensive measures like innovative shop floor practices, process simulation, automation, spill control in material handling and source-segregation of waste streams for onsite and offsite processing are deployed to achieve zero emission. Such transformation reduces the pressure of ongoing activity on natural resources on one side and landfill on the other.

ZIMI thus comprises of alternative process-practice modules that are standardized for global replication under similar situations thus affording a large multiplier effect through demonstrative extension. These modules are essentially cost effective and ensure a rapid payback on account of reducing costs of inputs, waste elimination and redundancy of compliance costs and liabilities. Technologies involved range from very basic separation techniques to very advance processes like super critical extraction, freeze drying, vacuum drying, microwave heating, electron beam metallurgy, hydrogen energy, fusion energy and so on. Extensive application of endothermic and exothermic processing along with biotechnology and catalysis is practiced together with electron beam, thermal plasma, electron pulse and ozone technologies. As a thumb rule, physical processing gets priority above chemical processing as benign alternative with least environmental impact.

Zero impact manufacturing, is all the more relevant to management of chemicals and in particular to the objectives of SAICM in as far as ensuring safety health and environmental excellence is concerned. It may be essential to appreciate that ingredients like material and process substitution, total recycling, waste exchange and by-product synergy actually aim at risk elimination rather than risk reduction or management. Shop floor demonstrations of ZIMI modules have shown remarkable post implementation reduction in total environmental impact of modified activity often leading to near zero or zero environmental impact with stray examples of a positive overall environmental impact.

Some of the significant ZIMI modules with measurable impact mitigation potential and proven payback may be mentioned as below.

Innovative technology module	Significant features
Vacuum evaporation of plating effluent	Zero discharge, reuse of spent chemicals
Membrane concentration of fruit juices	Zero energy, zero emission, high quality
Microwave drying of potato powder	Low energy, zero emission, one step cook-dry
Super critical CO ₂ dyeing	Waterless processing, zero emission, toxic waste elimination
Ozone sanitation of foods	Elimination of biocides & carcinogens used in disinfection and preservation
High rate bio-methanation of distillery spent wash and sugar press mud	Energy recovery, capturing greenhouse gases, compost production, low discharge and profits
CIP of dairy plant with ozonized water	Elimination of acid, alkali & detergent with saving of freshwater @ 0.2 lit/lit of milk
Ultrasonic cleaning and degreasing of components	Elimination of cleaning chemicals and toxic solvents, VOC emission reduction.
Detergent free washing & scouring of textiles using electrolyzed water & ultrasonic devices.	Elimination of cleaning chemicals and detergents used in textile industry.
Lignin recovery from black liquor in pulp & paper industries	By-product synergy, chemical recovery, water recycling, elimination of waste stream
Thermal absorption/solar refrigeration	Waste heat utilization/zero energy, CFC/ODS elimination, greenhouse effect mitigation
Condensate recovery & reuse in sugar, dairy, fruit juices and vegetables	Zero freshwater, zero discharge
Reuse of spent caustic from production of zirconium oxide in pulp mill	Waste exchange practice involving valorization of waste stream, cost effective substitution of prime materials, cleanup & zero emission. Positive impact intervention
Reuse of pickling acid waste as flocculent in effluent treatment plant	Eliminates waste stream, valorization of waste, substitution of fresh chemical & zero emission
Electron beam metallurgy	Low energy, zero freshwater, zero emission, one step forming. Eliminate foundry chemicals

Power point presentation on the basic concept of ZIMI and case studies built upon interventions listed above would amply establish the usefulness of ZIMI as a strategic initiative to mitigate the global environmental impact of human and industrial developmental activity and to combat the climatic changes set in as a direct consequence of such activity. The approach could be universally applied to transform enterprises into zero impact entities through application of ZIMI modules that are easily replicable and universally applicable. The most significant feature of ZIMI is that it uses innovation and application of knowledge to reverse the process of environmental degradation without

affecting the pace of development. It is equally significant that the concept could be used for rapid transformation of existing third world enterprises for environmental excellence beyond compliance with minimal investment, handsome payback and sustainable competitive advantage without disrupting the production process. Cleantech Foundation has undertaken ZIMI as a mission initiative for global proliferation and offers services without profit motive for field level implementation of ZIMI for transformation of small and medium enterprises anywhere in the world. The foundation also encourages strategic partnership initiatives at a global level for proliferation of these techniques for global environmental protection through training of local practitioners in the third world, providing consulting services and facilitating demonstration projects. It is firmly believed that a true participatory initiative based on ZIMI could very effectively facilitate sound chemicals management and serve the objectives of SAICM without affecting the pace of sustainable development.