EXECUTIVE SUMMARY

1.0 Background Of The Study :

The Indian chemical industry has been one of the driving forces for industrial growth and has contributed immensely to the social and economic development of the country. The Small scale chemical manufacturing sector has grown phenomenally in the last three decades and today, manufactures wide range of organic chemical intermediates and finished products which find application in many sectors of industry such as dyes and pigments, pesticides, drugs, leather chemicals etc.

The manufacture of organic chemical intermediates involves a number of stages and production is based on variety of unit processes and unit operations. These intermediates are generally produced in batches and the units have flexibility to produce two or more chemicals on campaign basis. This results in generation of process wastes of varying quantity and characteristics.

The production capacity in SSI units being small, it becomes much more difficult and uneconomical to treat the effluents before disposal. These effluents on entering common effluent treatment plants upset the bacterial system and adversely effect the functioning of the plants.

Hence, Central Pollution Control Board initiated this study to ascertain whether certain chemicals produced by this sector be continued to be produced or not or whether some minimum level of production can be fixed to ensure pollution control in such units.

1.1 Objectives of the study:

- Listing of chemicals produced by small-scale sectors.
- Statewise distribution of the SSI units with corresponding chemicals manufactured.
- Manufacturing processes adopted alongwith the material balance.
- Estimated quantity of wastewater generation and water consumption for each chemical.
- Estimated emissions from the manufacturing processes.
- The present status of emission and effluent control.

Whether alternative production technologies for the SSI units are available to obviate pollution control systems and if not, identify those chemicals produced by the SSI which should be banned owing to the inability of the units either to change over to clean technology or treat the waste.

1.2 Scope of Work:

A. Present Work :

1) Rationale for the selection of industries
2) Identification and selection of group of industries.
3) The probable conflict Economy v/s Environment.
4) Distribution of group of industries in a representative State - Maharashtra
5) Methodology of the project

B. Phase II Work :

1) Collection of data, flow-sheet and information.
2) Manufacturing process and material balance.
3) Quantum of waste generation-Theoretical prediction.
4) Selection of representative industries on each group for indepth study in order to have a correlation between observation and prediction.
5) Best practicable means for
   - Improvement of production technology
   - Suitable pollution control devices
   - Combination of above two
6) Cost aspects of best practicable means with reduction to desired level.
7) Annual Burden to Annual Turnover ratio.
8) Minimum level of production capacity in order to ensure pollution control under E.P Act, 1984, Air Act, 1981, Water Act, 1974.

1.3 Selection of subsectors :

After reviewing the categories of chemicals manufactured in the country, it was decided to select following four subsectors for detailed study :

a) Dyes & Dye Intermediates
b) Drugs & Drug Intermediates
c) Pesticides & Pesticide Intermediates
d) Leather Chemicals

The rationale behind this was :

- Large number of manufacturing units distributed all over the country
- Share estimated to be almost 40% of the total production

- Handling/processing a wide variety/range of organic chemicals exhibiting varying degree of toxicity
- Manufacture of products based on single to multistep processes involving variety of unit operations

1.4 Methodolody:

In order to meet various objectives, the study was divided into three phases as under:

Phase I - National Study on Small Scale Chemical Manufacturing Units

This included visits to various industrial areas housing SSI units to identify chemicals manufactured in the identified subsectors, study geographical distribution, production statistics, status of technology and status of pollution control.

Phase II - Data Assimilation & Desk Study

This included discussions with experts to :

- Make consolidated list of chemicals manufactured by each subsector
- Study of eco-toxicological properties using literature sources and computer databases (ECOTOX/ASTER/HSDB etc) for parameters such as
  - Acute toxicity (in terms of LD_{50} Oral/Dermal values/LC_{50} Aquatic values)
  - Specified long term effects (Carcinogenicity, Mutagenicity, Teratogenicity)
  - Bioaccumulation (in termsof Octanol Water Partition Coeffecient, log P_{oct} & Bioconcentration Factor, BCF)
  - Persistence (in terms on Biodegradation Half Life, $BOD_{1/2}$)
- Ranking of chemicals and their shortlisting based on toxicity to identify candidate substances for banning, phaseouts or reduction.

Phase III - Case Studies

This included field studies to 3/4 units manufacturing selected six chemicals, study of production processes, physico-chemical-eco-toxicological properties, study and discussion on efforts carried out to minimise wastes and working out theoretical and practical material balances. Annual Burden, AB (i.e Annual Operating Cost for suggested Waste Treatment/Waste Minimisation measures) & Annual Turnover, AT (i.e selling price x production capacity) were computed. Ratio of AB/AT was used to determine Minimum Level of Production

(AB/AT=1.5) whereas Desirable level of production was arrived at AB/AT=1.

1.5 Report:

The study report is presented in three volumes as under :

Volume I : Includes the following :

Chapter 1	Introduction and background
Chapter 2	Overview of SSI sectors selected with reference to historical development, broad classification, geographical distribution, products manufactured & production capacities
Chapter 3	Status of technology for manufacture of various chemicals in the different subsectors including unit processes & operations as practiced in SSI
Chapter 4	Infrastructure & status of pollution control
Chapter 5	Toxicological & ecological aspects of chemicals in the four subsectors, including selection of toxicity parameters and criteria adopted for ranking & shortlisting of chemicals for banning /phaseout & reduction
Chapter 6	Concept of minimum level of production
Chapter 7	Case study abstracts
Chapter 8	Findings of study
Chapter 9	Shortcomings of study
Chapter10	Recommendations

Volume II - (Annexures I - XXXI)

This presents tables giving the detailed list of dye/drug/leather chemicals & pesticides & their intermediates alongwith their production statistics, toxicological information. Criteria adopted for ranking/shortlisting of chemicals based on toxicity, rank's assigned based on the criteria & shortlisting of chemicals for banning, phase outs &/or reduction.

Volume III - Case studies (Annexure XXXII)

This presents detailed document on physico- chemical-environmental properties, production technology employed, effluent/hazardous waste characterictics, theoretical & practical material balances, suggested effluent/waste treatment/waste minimisation methodologies, cost implications and additional annual burden of such measures for the six chemicals selected for case studies. Graphs and Tables giving Annual Burden/Annual Turnover (AB/AT) v/s production capcities are presented. Impact on cost per kg of product at different AB/AT values is also presented.

1.6 Observations and Findings :

I) National Study of Small Scale Sector Manufacturing Chemicals :

Based on the Nationwide survey conducted on Small Scale chemical sector, followed by detailed study of various sub-sectors, our findings are as under :

a) Incentives and concessions induce SSI units to remain under the umbrella of small scale & opt for multiple small units in lieu of expansions.

b) Ready availability of various organic intermediates alongwith Government policy on economic reforms and liberalisation to boost exports have resulted in unprecedented growth of small scale sector in the above mentioned sub-sectors.

c) Large & medium scale sectors offload labour intensive- low volume-high hazard products to small scale sector and restrict their activity to high value products based on modern technology and utilising minimum manpower. This has further stimulated growth of SSI in above sub-sectors.

d) The National Survey on SSI indicates that there are about 750 chemicals manufactured in the identified sub-sectors comprising of Dyes (366), Dye intermediates (192), Drugs (60), Drug Intermediates (102), Pesticide intermediates (23) & Leather Chemicals (9).

e) It is seen that majority of dye-dye intermediate manufacturing units are based in Gujarat (1371) followed by Maharashtra (321), whereas other states (Rajasthan, West Bengal, Tamil Nadu, Andhra Pradesh & Haryana) account for remaining 125 units. The districts of Ahmedabad (630) and Vapi (277) are the major production centres in Gujarat. Out of total 1821 units, it is estimated that 1350 units are in operation (1050 in Gujarat/225 in Maharashtra).

   In the Drugs and Intermediates sub-sector, Maharashtra leads other states in terms of number of units, followed by Gujarat, Andhra Pradesh and West Bengal.

   Technical grade Pesticides are not made in SSI. The units producing Pesticide Intermediates are only in Gujarat and Maharashtra. SSI sector is very active in the manufacture of Pesticide formulations and these units are spread throughout the country.

   As regards Leather Chemicals, the SSI sector is engaged in the production of formulations only.

f) In the Dyes sub-sector, the SSI units produce major class of Dyes like Azo, Acid, Basic, Direct, Reactive, Phthalocyanine pigments, Optical Brighteners etc and account for about 50-55% of the total dyes production. However, Disperse, Vat, & Solvent Dyes are not produced in SSI due to technology constraints and large investment need.

SSI sector produces practically all modern drugs (40% of the total production) except patented drugs, basic Antibiotics, Vitamins, Vaccines, Steroid Hormones and other speciality drugs which require high investment & modern technology. SSI are very active in the field of pharmaceuticals formulations.

SSI do not produce bulk technical grade pesticides due to the various requirements under Insecticide Act. However, in the pesticide formulations, share of SSI is 50-55% of the total.

Role of SSI in leather chemicals is restricted to re-packing and formulation & it accounts for 30% of the formulation business.

SSI sector has been very active in the area of organic intermediates required for manufacture of Dyes, Bulk drugs and Pesticides and accounts for 65% of the total production.

g) Dyes, Drugs and Organic intermediates are produced batchwise in multi-purpose plants and 3-5 products are made on campaign basis (based on market demand). This involves single to multi stage production steps & handling of large number of raw materials & intermediates. The manufacturing technologies adopted are out dated and based on technologies adopted in Germany prior to Second World War. Subsequent technological developments incorporating automation/ mechanisation to prevent human exposure are generally not adopted in SSI.

h) Production of chemicals on campaign basis and switch over from one product to another, results in generation of liquid effluents with widely varying characteristics containing dissolved raw materials and intermediates having high toxicity.

Generally, SSI units are seen to provide only rudimentary facilities (such as neutralisation-sedimentation) to treat the effluents which are incapable of removing the dissolved organic materials.

i) Raw materials, intermediates and end products have high oral/dermal toxicity, are known/suspected carcinogens, corrossive and/or hazardous in nature & are handled in the most unsafe manner, exposing the workers to hazards.

j) Infrastructural facilities in the industrial estates built by GIDC and MIDC reveals that facilities provided by GIDC are not upto the mark, with many industrial areas not served by underground drainage, CETP and other basic facilities.

II) Toxicological Studies on Chemicals Manufactured in SSI :

Studies carried out to assess toxicity of chemicals manufactured in SSI and to identify candidate substances for banning, phase-outs and/or reduction in production indicate the following :

a) Out of 366 dyestuffs manufactured in SSI, toxicity data is available only for 71 indicating that dyestuffs, as a class have not been evaluated much for their toxicity.

   Bulk Drugs have been generally extensively tested both in-vivo and in-vitro because of nature of their application.

b) Ranking and shortlisting of chemicals resulted in 57 chemicals (mostly intermediates) and 12 drugs categorised as Track1/Track2/Track3 as per their level of toxicity. The drugs have been seperately listed as their toxicity is extensively reveiwed prior to introduction and information on quantum of discharge to environment is not available.

c) Thirty one chemicals identified as Track 1/Track 2/Track 3 in this study also figure in International Critical Pollutants lists such as Priority Pollutants (USEPA), Primary & Secondary substances (Canadian Ministry of Environment and Energy), Michigan Critical Materials Register etc.

d) It is observed that fourteen of the identified Track1/Track2/Track3 chemicals appear in the list of chemicals reserved for SSI sector.

e) Study of Toxicity data on Dye/Drug & Pesticide intermediates indicates that lipophilic aromatic amines (such as Benzidine, α-Naphthylamine, Anisidines, p-Aminophenol) and chloronated organic intermediates (such as Benzoyl chloride, Benzotrichloride and p-Chloroaniline) pose the most severe threat to environment and human health.

III) Case Studies to Identify Minimum Level of Production:

a) Field studies carried out on six chemicals indicate that there are substantial losses of chemicals at various stages of manufacture & highly polluted effluents & sludges containing dissolved toxic organics are discharged into the environment. These may up set the

CETP or cause negative impact on human health and the environment.

b) Field studies indicate that the storage & handling of toxic chemicals are unsatisfactory & have high exposure potential for employees.

c) Ratio of Annual Burden, AB, to Annual Turnover, AT, has been used as a tool for calculating the Minimum/Desired level of production. Physico chemical treatment has been suggested viz. Solvent extraction &/or adsorption to reduce the level of organic pollutants before sending the same to CETP. Incineration has been suggested for two chemicals. The ratios have been worked out considering prevailing process technologies. Whenever simple physico-chemical methods, such as solvent extraction & adsorption can be employed, AB/AT ratio of 1.0 and 1.5 holds good & impact on cost per kg of product is minimal.

However, wherever very high cost treatment alternatives such as incineration are considered, AB/AT ratio of 4 to 5 was observed.

1.7 Shortcomings of the Study :

A) Toxicity hazard assessment/evaluation procedure :

- ❖ The approach adopted in this report is restricted to identification of chemicals of greater environmental concern from a water oriented point of view, i.e. those chemicals which pose maximum hazard to aquatic environment.
- ❖ The shortlisting procedure is based on total toxicity score and therefore, chemicals for which sufficient toxicity information is lacking, can not be included via the hazard assessment process.
- ❖ The procedure uses a worst-possible-case approach rather than weight-of-evidence approach.
- ❖ The toxicity assessment is based on secondary information accessed through various literature sources/computerised data bases.
- ❖ Lack of inventory data on chemical manufacture and usage makes it impossible to determine environmental health risk.
- ❖ Lack of information regarding exposure of humans to toxic chemicals during different stages of the life cycle of the chemical and information regarding concentration of chemicals in the environment makes it difficult to assess total environmental exposure.

B) Identification of minimum level of production to ensure pollution control :

The identification of Minimum level of production is based on two parameters viz Annual Burden (AB) & Annual Turnover (AT).

Both parameters are liable to change as per following :

ANNUAL BURDEN (AB) :

The existing case studies have been worked out assuming certain physico chemical methodology of treatment uch as solvent extraction, adsorption & incineration.

Newer technologies for Effluent Treatment are being introduced which will directly affect operating cost, so this parameter is bound to change depending upon treatment technology considered.

Some chemicals can be treated by different techniques, in such cases different sets of AB/AT values can be obtained for same annual turnover due to change in treatment cost. In such a case, the least-costly-most effective technology should be selected for evaluation.

ANNUAL TURNOVER (AT) :

Annual Turnover has been taken as average selling price for last five years multiplied by annual production (in Tons). The figure is thus liable to change depending upon market fluctuations.

1.7 Recommendations:

Following Recommendations are made for consideration of Central Pollution Control Board and it is requested to take up suitably with the Government of India for making appropriate policy measures:

1. Comprehensive approach to managing chemicals :

The first and foremost issue of importance is to prepare an action plan with specific time frames for managing chemicals produced/likely to be produced in the country, by both Organised and Small scale sector. The following steps are recommended:

a) DATABASE ON CHEMICALS

i) Compilation and listing of chemicals :

As first step, comprehensive list of “Existing” chemicals manufactured in various sectors of the chemical industry in both

organised & small scale units in the country, should be compiled. This will help formulate legislation for controlling existing and new chemicals. U.S.A., Canada & some European Countries already have such lists.

ii) Development of toxicity database :

A comprehensive ecotoxicological database should be generated, maintained and continuously updated. This is an important ingredient for all phases of managing chemicals. Initially, such information can be sought from various existing source like.

- ❖ CESARS of Canadian Ministry of Environment & Energy.
- ❖ DOSE of UK
- ❖ ASTER/ECOTOX/ACQUIRE of USEPA
- ❖ CHEMFATE/ENVIROFATE of U.S.

Later efforts should be directed at obtaining primary references (i.e. original texts of published data on toxicity) in order to understand the toxicity characteristics & various controlling factors at the time of conducting laboratory/field tests.

iii) Information on Production statistics :

A system needs to be developed for obtaining production related information, particularly for toxic chemicals. This alongwith life cycle analysis would help to assess exposure potential of such chemicals to humans. The need for such information has prompted Environmental authorities in developed countries to generate such database.

The Environmental Audit procedure has to be strengthened to obtain complete data on installed/licensed capacities and actual production figures in respect of toxic organic chemicals manufactured in the country.

The Central Pollution Control Board should rely on its own “arms”, i.e. the State Pollution Control Boards as information sources.

b) <u>LIFE CYCLE ANALYSIS</u>

The present approach of Indian legislation on hazardous and toxic chemicals revolves around manufacture, storage & transport. However, aspects of chemical being used/consumed & exposure to general population is not considered. Persistent chemicals may travel great distances and may affect population

far removed from the location of manufacture/storage and transport.

It is recommended to take up Life Cycle Analysis of toxic chemicals to help understand exposure potential to humans & identify population at risk.

It may be mentioned that life cycle assessment for new toxic chemicals has been made compulsory by the Canadian Ministry of Environment and Energy.

2. POLLUTION CONTROL :

It is essential to develop chemical specific approach to pollution control rather than prescribing the pollution in terms of Biological Oxygen Demand & Chemical Oxygen Demand. Case studies conducted reveal that the liquid and solid wastes are invariably contaminated with raw materials, products/by-products. The following steps are recommended for further action :

a) Identification of priority pollutants :

In the present study, out of 750 chemicals manufactured by Small Scale Industries about 57 chemicals have been identified and categorised as :

- Track 1 (immediate banning by SSI sector)
- Track 2 (phase-out/reduction or review)
- Track 3 (reduction or review)

It is recommended to extend the study to cover the entire gamut of chemicals manufactured in the country & rationalise the criteria for shortlisting of chemicals. A “Priority Pollutants” list should be prepared based on this rationale.

b) Development of Criteria for discharge of toxic wastes to the environment :

A logical next step would be to specify criteria for discharge of “Priority Pollutants”. This would enable the concerned Central/State pollution control boards to have proper control on discharge of such chemicals.

USEPA has identified 129 chemicals as “Priority Pollutants” and specified acceptable levels of discharge on daily/weekly/ monthly basis.

Similarly Canadian Ministry of Environment & Energy has identified chemicals as "Primary List" & "Secondary List".

"Primary List" chemicals are those chemicals recommended for banning, phase out or use/release reduction in that order of preference, with an emphasis on pollution prevention/control techniques. "Secondary List" chemicals are those for which discharge criteria are specified and/or their manufacture, usage & handling is under review.

3. TOXICITY HAZARD ASSESSMENT :

On the basis of toxicity hazard assessment studies conducted for chemicals produced by SSI, certain chemicals have been listed and identified as Track 1/ Track 2/Track 3 for further action. It is recommended to :

- Immediately ban substances identified as Track 1 for production in SSI.
- Have detailed review of chemicals identified as Track 2/Track 3.
- Track 2 substances may be phased out depending upon their detailed evaluation after 4/5 years.
- Specify criteria for discharge of Track 2/Track 3 chemicals.
- Review manufacturing processes of shortlisted drugs from environmental angle & take final decision regarding banning, phase-out etc. in Small Scale Sector.

Future work on toxicity hazard assessment/evaluation may include the following parameters :

- Evaluation of chemicals made by both Organised & Small Scale Sector.
- Consideration of additional parameters such as
  - Inhalation toxicity
  - Persistence in air/soil/other media
  - Other hazardous properties such as flammability/corrosivity/ explosiveness.
- Information feedback from field monitoring
- Modification & updating of databases as new information becomes available.
- Develop a mechanism for further review by experts.
- Formulate procedure for listing-delisting of chemicals.

4. DETERMINATION OF MINIMUM LEVEL OF PRODUCTION:

Proper application of economic principles to environmental problem becomes essential in order to identify and implement the most cost effective solutions. AB/AT ratio as a tool seems to succeed, in that, it helps SSI units to maintain viability of the project and thus leaves

no room for not implementing pollution control systems. In this respect it is recommended :

- ❖ To extend study to cover all chemicals identified as Track 2/ Track 3 in this report.

- ❖ Cost effective treatment technologies are the best incentive to induce SSI sector to adopt necessary effluent treatment methods. A special cell comprising of chemical/environmental engineers needs to be created in CPCB to understand specific problems of small scale industries with respect to treatment of effluents and to develop appropriate methods of treatment.

- ❖ For the six chemicals covered in the case studies, it is recommended to:

  a) Notify Minimum/Desirable levels of production along with recommended treatment technology to be adopted.
  b) Require SSI units manufacturing these chemicals to switch over to cleaner technologies as suggested or face ban.
  c) Take up R & D studies to optimise processes aimed at improving safety, reduction of waste and/or reducing worker exposure to toxic chemicals, such as :
     - Development of ambient pressure methoxylation process for o-Anisidine
     - Use of Polystyrene acidic resins for extraction of meta Phenylenediamine
     - Development of Dissociative Extraction process for treatment of m-Phenlyenediamine effluents
     - Purification of 1-Nitronaphthalene using sweating process during the process of α-Naphthylamine manufacture
     - Use of chlorinated solvents like Methylene chloride to reduce consumption of Chlorosulfonic acid in Stage-I of Vinyl Sulfone manufacture
     - Optimise use of Ethylene oxide in ethoxylation stage (Stage III) of Vinyl Sulfone manufacture
     - Manufacture of Vinyl Sulfone using Sulfanilic acid & Acetic acid in presence of Thionyl chloride/Methylene chloride in Stage I

– Development of Catalytic Hydrogenation process for manufacture of aromatic amines in small scale

5. CAPACITY BUILDING MEASURES :

It is essential to impart necessary training to the officers and field staff of pollution control boards and equip them suitably. This will enable them to understand and manage the toxic chemicals issue as described in the report during normal situations and emergencies.

Measures should evolve around :

- ❖ Analytical capacity building to monitor environmental contaminants in various media.
- ❖ Development, use & updating of database for chemicals manufactured in the country.
- ❖ Development, use & updating of eco-toxicological database.
- ❖ Study transport/transformation processes for organic chemicals & develop suitable models to study and evaluate environmental fate of organic pollutants for Indian conditions.

6. POLICY INITIATIVES :

Following general/specific policy measures are suggested :

a) Zoning :

Zoning of chemical industries should be given top priority for containment and management of toxic organic chemicals. SSI units should be permitted to be set up only in approved chemical zones. District wise zoning studies should be undertaken for identification of suitable sites. Chemical units presently set up and operating in areas other than the chemical zones should be asked to relocate in the approved areas.

b) Infrastructure :

As a rule, industrial areas housing chemical units must provide under ground drainage, CETP and facility for pumping of treated effluents to designated discharge locations. Hazardous waste utilisation and/or disposal facilities should also be created. Such facilities should be provided in all existing industrial estates with a time bound programme for implementation & be a pre-requisite for new industrial estates, whether private or Government. Grant of Consents to Industrial estates should be made compulsory to ensure time bound implementation of infrastructure related measures and to check conformity to zoning policy.

c) Capital investment Limits and Concessions:

As can be seen, the current scenario is to enjoy concessions by operating under the umbrella of SSI. This is resulting information of large number of units and a tendency to remain small. It is strongly recommended to

- ❖ Review and revise the investment limit from time to time, keeping in line with inflation.
- ❖ Have phased program whereby units which are in small scale can avail part benefits even when they grow from small to medium scale sector.
- ❖ Give excise duty concessions only for specific period since commencement of production.
- ❖ Exempt the investment made for pollution control while calculating the expenditure incurred on plant and machinery.

d) Reservation of items for SSI :

During the course of this study, it was observed that quite a few chemicals reserved for SSI are highly toxic and hazardous in nature & 14 items have been identified as Track1/Track2/Track3.

It is recommended to review existing list of reserved chemicals for SSI from toxicity/hazard angle and new addition to the list should be decided after giving due weightage to the above criteria.

e) Technology :

Many of the unit processes and operations employed in Small Scale Industries are antiquated. It is recommended to undertake a fresh review of the same & suggest improvements to achieve better efficiencies. Upgradation of existing technologies should be considered as a short and long term strategy. National laboratories under CSIR may be entrusted this task.

f) Financial Incentives :

It is recommended to increase investment ceiling for SSI units adopting clean technologies. For example, Aromatic amines like Aniline, Toluidines, α-Naphthyl amine, Chloro anilines and other substituted amines are generally manufactured from corresponding nitro aromatics using iron and acid. The process generates solid waste in the form of Iron oxide sludge contaminated with organic pollutants (amino and nitro compounds). The modern method is to reduce nitro compound

with hydrogen gas in presence of catalyst; wherein no solid wastes are generated and high efficiencies are achieved. This is a clean technology. The investment for such technology is

comparatively high. The SSI units adopting such technologies should have a separate investment criteria.

Interest free loans or low interest loans maybe considered to encourage Small Scale Industries to invest in Pollution control systems &/or switch over to cleaner technologies. Excise duty/Sales tax concessions be considered as a long term measure for units adopting cleaner technologies. Some of the possible options can be as below :

- ❖ Higher ceiling for application of excise duties
- ❖ Tax holiday at Central/State level

g) Legislative Issues :

Efforts towards this should be made to :

- ❖ Developing a preventive rather than reactive approach to managing chemicals
- ❖ Clearly spell out a policy for toxic chemicals manufacture in the country.
- ❖ Establish coordination and consistency in chemicals management.
- ❖ Take all stakeholders into confidence and have both regulatory and voluntary program for reduction of toxic chemicals.
- ❖ Frame suitable Rules to manage new and existing Toxic Substances in line with the Toxic Substances Management Act of the U.S.
- ❖ Strengthen audit requirement particularly where manufacture of toxic chemicals is involved.