

ASSESSMENT OF THE REGULATORY ASPECTS OF SUPPLY CHAIN MANAGEMENT OF HAZARDOUS MATERIALS, (HAZMAT) WITH RESPECT TO THE INDIAN CHEMICAL INDUSTRY

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Abstract:

Purpose of this Paper

HAZMAT, defined as materials which can harm people, organisms & environment are a critical part of the industry supply-chain as raw material, intermediates or finished products. A strong & effective regulatory frame work for dealing with HAZMAT & proper management is of utmost importance for ensuring adequate safety & minimizing risks during different stages of supply chain (manufacturing, storage, transportation). In view of this, the objective of research was to study the prevailing regulatory framework for supply-chain management of HAZMAT in context of Indian chemical industry.

Methodology/Approach

The methodology opted for a literature survey of the HAZMAT regulatory frame work, classification of the multiple Acts & Rules in India, in accordance with different stages of supply chain. The study expands by comparative assessment with some best practices in EU & recommendations.

Findings

The research conducts gap-analysis of the prevailing regulatory structure & develops a theoretical frame-work for better HAZMAT management in India.

Research Limitations

The research is limited to HAZMAT in the context of Indian chemical industry.

Implications

A strong regulatory frame-work for Supply Chain Management of HAZMAT is imperative to ensure safety & risk mitigation due to their significant usage as raw-materials, intermediates or finished products in a wide variety of industries. The research contributes to the body of knowledge in this field & gap-analysis to improve supply-chain management of HAZMAT in the Indian context.

Keywords; Supply chain management, HAZMAT, Chemical industry, Environmental Protection Act, EUROPEAN UNION REGULATION GOVERNING HAZMAT SUBSTANCES, (REACH)

Introduction: (HAZMAT & Indian Chemical Industry)

HAZMAT, [1] (Hazardous Materials) are defined as materials which can harm people, organisms & environment, either by itself or by complex interaction with other factors.

These materials are critical part of supply-chain process, as raw materials used in manufacturing, intermediates or finished products. Strong & effective regulatory framework for dealing with HAZMAT & proper management is of utmost importance to ensure adequate safety & minimize risks during the different stages of supply-chain (manufacturing, storage, transportation).

The Chemical industry is among the oldest industries in India with significant contribution to the industrial growth & it is largest consumer & generator of HAZMAT. There are large number of small, medium & large scale units estimated to manufacture over 80,000+ commercial products [2]. Indian chemical industry, is valued at nearly USD 163 Billion/annum (FY17-18) & is projected to reach USD 403 Billion/annum by 2025. India ranks 4th in Asia & 6th in the world in chemical sales & has witnessed sizeable growth. Between the years 2010-2015, it posted a strong CAGR of 13% & is forecasted to have a CAGR of 8% to 10% by 2025 Increasing development across multiple end-user sectors coupled with growing middle class & increased urbanisation are compelling drivers for this growth. India's preparedness with respect to the HAZMAT is therefore quite important, to ensure safety & risk reduction during the different phases of the supply chain & to ensure growth momentum in "chemical industry" is continued.

Chemical Management In India

Ministry of Environment & Forests (MoEF), is the main nodal agency for the "chemical management" in India & under it the Environmental Protection Act, 1986, 1991, stipulates foundation for regulations of HAZMAT.

HAZMAT are materials possessing any one of the following characteristics (As per Schedule I of Act) [3]

Toxicity: Materials having the following values of acute toxicity and which, owing to their physical and chemical properties, are capable of producing major risk to human health and other living organisms.

No.	Degree of Toxicity	Medium Lethal Dose by oral route (oral Toxicity, LD50, (mg/Kg)	Medium Lethal Dose by dermal route (dermal Toxicity, LD50, (mg/Kg)	Medium Lethal Dose by inhalation route (~4 hrs), LD50,(Mg/Kg)
1	Extremely Toxic	1-50	1-200	0.1-0.5
2	Highly Toxic	51-100	201-2000	0.5-2.0

Flammability: Materials with Flash Point of 20 deg C or below

Explosivity: Materials which may explode under the effect of flame, heat or photo-chemical conditions. Any other material under the Indian Explosive Act.

Acidity: Materials with Ph <=5 which may be corrosive by, chemical reaction, will cause severe damage in contact with living tissue.

Alkalinity: Materials with $pH \geq 9$, which may be corrosive & will cause severe damage when in contact with living tissue

Carcinogenity: Materials which through exposure can cause are established to cause cancer in humans and animals.

Under the Schedule III, [4], HAZMAT materials have been defined as the following

UN Class *	Code	Characteristics
1	H1	Explosive
3	H3	Flammable Liquids
4.1	H4.1	Flammable Solids
4.2	H4.2	Substances or wastes liable to spontaneous combustion
4.3	H4.3	Substances or wastes which in contact with water, emit Flammable gases
5.1	H5.1	Oxidizing
5.2	H5.2	Organic Peroxides
6.1	H6.1	Poisonous (Acute)
6.2	H6.2	Infectious substances
8	H8	Corrosives
9	H10	Liberation of Toxic gases in contact with water or air
9	H11	Toxic (Delayed or Chronic)
9	H12	Eco-Toxic

UN Class*- *Corresponds to the hazard classification system included in the United Nations Recommendations on the Transport of Dangerous Goods (ST/SG/AC.10/1 Rev.5, United Nations, New York, 1988)*

Multiple Act & Rules, have been laid down for chemical management in India, broadly classified into these groups:

- Laws related to manufacturing of chemicals
- Laws related to transportation of chemicals
- Laws related to protection of environment and public health

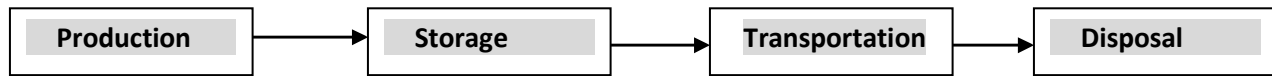
Acts & Rules have been framed for each of the above groups. However, the Environment (Protections) Act, 1986, 1991, [3], serves as umbrella Act and can link other Acts in one way or another, without interfering with the autonomy of any other Acts/Rules. Various ministries at Central and State level with their regulatory agencies are responsible for implementing the respective laws.

The Environment (Protection) Act, 1986, 1991 [3]

- Manufacture, Storage and import of Hazardous chemicals, 1989, 2000 [5]
- Hazardous waste (Management, handling & trans-boundary movement) Rules, 1989, 2000 [4]
- Chemical Accidents (Emergency planning, Preparedness & Response) Rules, 1996 [6]

- The Ozone depleting substances (regulation and control) Rules, 2000 [7]

We have attempted to classify the HAZMAT regulations hereunder as per the applicability within various critical stages of “supply chain”



Production	Storage	Transportation	Disposal
MSIC Rules	MSIC Rules	CA (EPPR) Rules	
CA (EPPR) Rules & Rules PLI Act & Rules (M&H) Rules HW (M&H) Rules	CA (EPPR) Rules PLI Act & Rules HW (M&H) Rules Insecticide Act & Rules Explosive Act & Rules Explosive Act & Rules	CMV Act & Rules Explosive Act & Rules Gas Cylinder Rules Explosive Act & Rules Petroleum Act & Rules Gas cylinder Rules	EP Act HW Gas
Cylinder Rules Factory Act & Rules & Rules Insecticide Act & Rules	ODS (R&C) Rules Factory Act & Rules Petroleum Act & Rules Insecticide Act & Rules	ODC (R&C) Rules Port Act & Rules Petroleum Act	

Compilation of Multiple Acts & Rules

Acts & Rules related to Environmental Management	The Environment Protection Act, 1986, amended 1991 [3] Environment Protection Rules, 1986 (amended 1999, 2001, 2002, 2004) Hazardous waste management & handling Rules, 1989, 2000, 2003 [4] Ozone Depleting substances (regulation & control) Rules, 2000 The Air (Prevention and Control of Pollution) Act, 1981, 1987 The Water (Prevention and control of Pollution) Act, 1974, 1988 The water (Prevention and control of Pollution) Rules, 1975 Ozone depleting substances (Regulation and control) Rules, 2000 [7]
Acts & Rules related to chemical safety & emergency management	Manufacture, Storage & import of Hazardous chemicals Rules, 1989, 2000 [5] Chemicals Accidents (Emergency planning, preparedness & response) Rules, 1996 [6] Public Liability Insurance Act, 1991 1992 [8] Public Liability Insurance Rules, 1991 1993 Factories Act, 1948 [9] The Dock workers (safety, health & welfare) Act, 1986 The Dock workers (safety, health & welfare) Rules, 1989

Acts & Rules related to specific chemical category/ Container	Petroleum Act, 1934 [10] Petroleum Rules, 2002 Explosives Act, 1884 Explosives Rules, 1983 Gas cylinder Rules, 2004 Insecticides Act, 1968 Insecticide Rules, 1971
Acts & Rules related to transportation	Motor Vehicles Act, 1988 [10] Central Motor Vehicles Rules, 1989 The Merchant Shipping Act, 1958 amended in 2002 & 2003 The Merchant Shipping (carriage of cargo) Rules 1995
Other Acts related to chemical Management	Customs Act, 1962, Indian Ports Act, 1908 National Disaster Management Act, 2005

Reach (A Perspective)

European Union Regulation Governing Hazmat Substances (Reach)

REACH [11] (Regulation concerning the Registration, Evaluation, Authorization & Restriction of Chemicals), is an EU Regulation of 18th Dec 2006. It addresses production and use of chemical substances, potential impacts on human health and environment & life cycle analysis of the impact of the HAZMAT. REACH makes the industry responsible for assessing, managing & mitigating the risks posed by chemicals and providing comprehensive safety information to all members in the supply chain (~manufacturers/importers, upstream and downstream users). REACH entered into force in 1st June 2007, with a phased implementation over the next decade. It mandates all companies manufacturing or importing chemical substances into the EU in quantities of one tonne or more per year to register these substances with a new European Chemical Agency (ECHA) in Finland. REACH also addresses continued use of chemical substances of very high concern (SVHC) because of their potential negative impacts on human health and environment. The ECHA needs to be notified of the presence of SVHC in articles if the total quantity used is more than one tonne/year & the SVHC is present at more than 0.1% of the mass of object. The authorization procedure also calls for detailed plans to replace the use of SVHC with safer alternatives or substitutes.

As of date nearly 143,000 substances have been registered under REACH & the strong data information management system under REACH (~EUCLID system[12]), allows for exchange of critical HAZMAT information among all members of the Supply Chain

Findings & Gap Analysis

- On the legislation front, from cradle to grave, India seems to have requisite number of Acts & Rules governing the management of HAZMAT substances & there is adequate regulatory framework in place. Further, since India is a signatory to the various multilateral agreements under the UN Charter, the HAZMAT regulations are being constantly reviewed and updated.
- However due to multiple stake-holders (ministries) involved in implementation of regulations, there is possibility of overlap of functions (~some stakeholders act as regulators, others as blend of developer, operator and regulator). Better

coordination & synchronization mechanism would help in implementation.

- Implementation of regulations needs to be strengthened & there is also need for tougher procedures for inspection, vigilance and penalty.
- Although there is progress towards centralized database for HAZMAT in India, this needs to be much more agile with real-time updates of HAZMAT inventory & facilitating better exchange of information within various members of supply chain (~upstream, manufacturers, distribution channel, downstream users). At present most of the data is managed by respective governmental agencies. Data analysis & latest analytics tools will help in evolving proper action plans. Crucial areas which need some improvement-

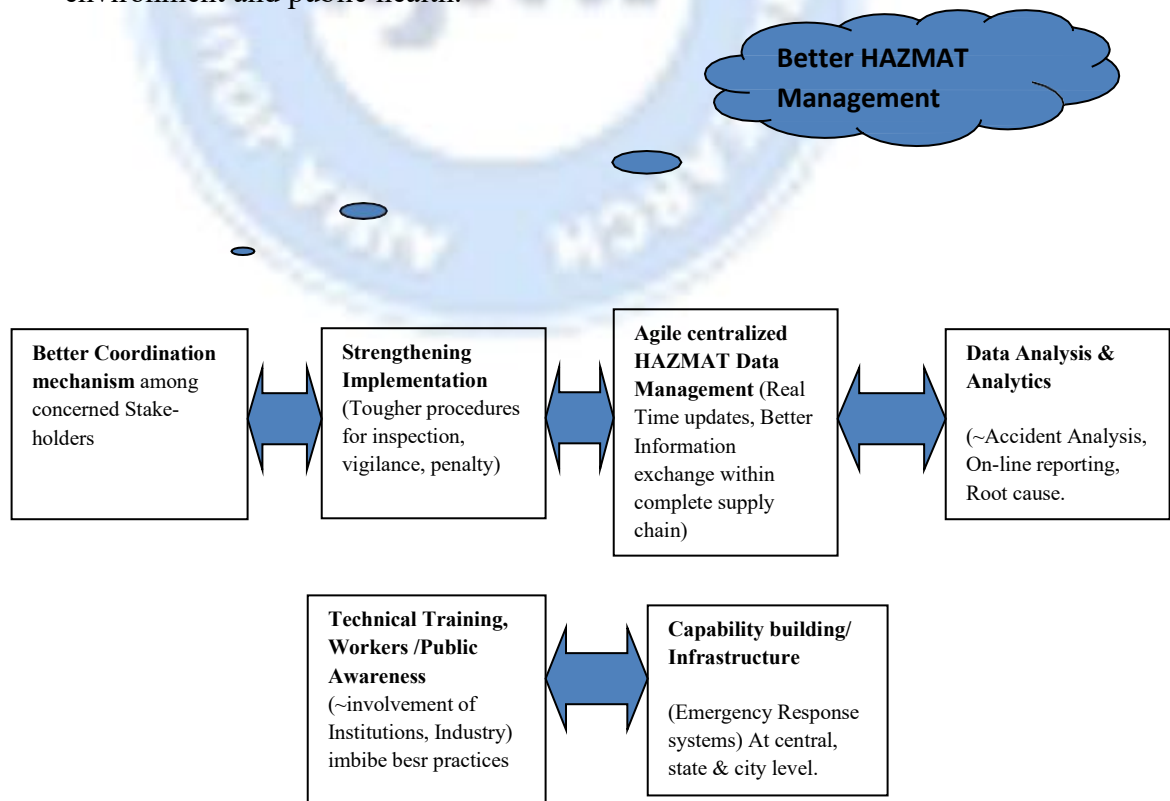
-Real-time updates on HAZMAT inventory facilitating better exchange of information within supply chain. AI Tools can also be used

-Integrated Data on health of industrial workers

-Integrated Data on HAZMAT accidents, on-line reporting & analysis

-Real-Time Exposure Data & tracking of chemicals

- Greater focus on technical training of “workers and public” on HAZMAT management & respective regulations. Increased involvement of industry, professional bodies & academic institutions. Constantly imbibing best practise from the world, as a dynamic process.
- Capability Building/Infrastructure for Emergency response
- Graduating to tougher laws such as (REACH) [11], which call for end to end life-cycle management of chemicals & ensuring greater degree of safety to environment and public health.



(Frame-work illustration for improved HAZMAT management)

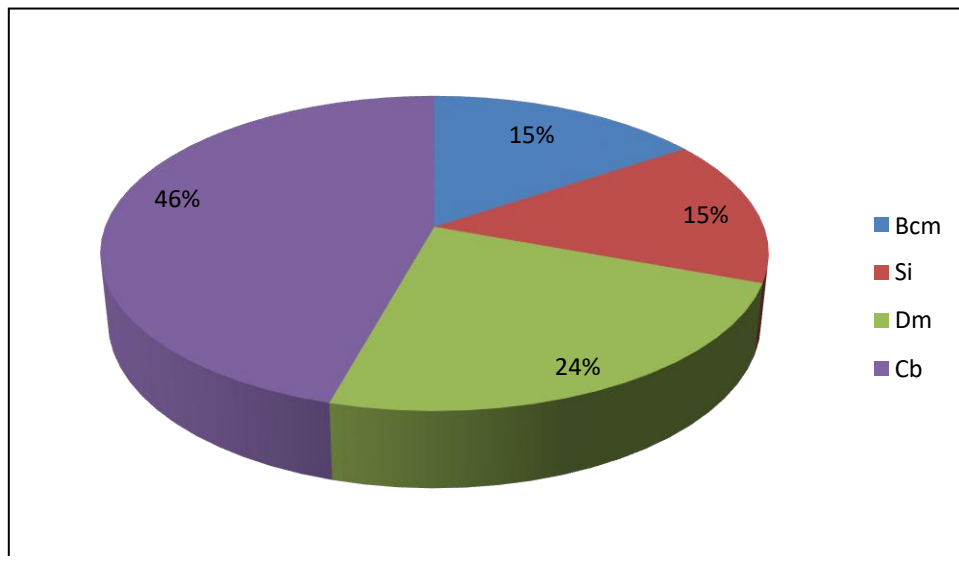
Recommendation from REACH Framework:

REACH	INDIA's HAZMAT
Integrated regulation governing HAZMAT. Replaced over "45" different regulations across EU	Increased integration will facilitate better HAZMAT management
Strong HAZMAT data-capture, analysis & management under system, called IUCLID IT [30] (International Uniform Chemical Information Database)	HAZMAT data management to be made more agile with real time updates & better information exchange
Strong inventory for over 143,000 substances & constantly growing	Database on HAZMAT inventories to be augmented deploying latest analytics
Focus on "life cycle analysis" of HAZMAT and their impact on human health and environment (~air, water, soil, aquatic life, plant life). Mechanism to track persistence in environment (~short, med, long term) & eco-toxicity & bioaccumulation	Focus is primarily on "direct impact" of HAZMAT on human-health & environment. Need to build capabilities for executing "life cycle analysis"
Makes industry (~manufacturers, importers) responsible for managing the risks posed by HAZMAT & providing information within supply-chain. Forces industry to substitute serious HAZMAT substance & plan for substitution in such cases	Responsibility mainly with occupier of HAZMAT. A governing mechanism for "substitution" of serious HAZMAT is needed.

Industrial Survey:

A small-survey of 19 No's chemical industries across India with revenues excceeding US\$ 20 Mill per annum, was executed to gain better insight of the four main input factors (X's) contributing to improvement in HAZMAT practices (Y) in India. The survey was conducted by mail followed by telephonic questionnaire.

No.	Input Parameter's (X's)	Scales (5-extremely important, 3-medium imp, 1-low imp, 0- not imp)
1	Better coordination mechanism (Bcm)	2 No's (~score-5), 3 No's (~score-3), 4 No's (~score-1), 11 No's (~score-0), (Tot Score-29)
2	Strengthening implementation (Si)	2 No's (~score-5), 4 No's (~score-3), 6 No's (~score-1), 8 No's (~score-0), (Tot Score-28)
3	Agile HAZMAT Data Management (Dm)	3 No's (~score-5), 7 No's (~score-3), 8 No's (~score-1), (Total Score- 44)
4	Capacity Building (Cb)	13 No's (~score- 5), 6 No's (~score- 3), 2 No's (~score - 1), 1 No's (~score-0) (Tot Score-85)



This has yielded improved insight & majority of nearly (46%) respondents felt that “capacity building” (cb) is major contributor to improvement of HAZMAT practices, followed by (24%) respondents (Data Management), 15% (strengthening implementation) & 15% (Better co- ordination mechanism). It is recommended that future efforts be driven towards greater capability building & infrastructure for HAZMAT management along with more agile data management capabilities, to ensure collaboration of information across the entire supply chain. Most respondents are also of the opinion that over the years the “coordination mechanism” between various HAZMAT agencies has definitely improved & there is adequate legal frame-work for ensuring proper implementation.

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- [10] Central Motor Vehicle Rules, 1989

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- [12] International uniform chemical information database, IUCLID, www.iuclid6.echa.europa.eu

