

**Terms of Reference for R&D Project under
(Chemical Hazards Sectional Committee, CHD 07, Chemical Department, BIS)**

1 Title: Study on safety practices followed in hexane industry.

2 Background:

2.1 BIS has formulated standard IS 10870: 1984 Code of Safety for Hexane which describes the properties of hexane derived as petroleum fraction in the boiling range of 63°C – 70°C. This standards prescribes nature of hazards associated with it, symptoms of toxicity, first aid, safety measures for controlling hazards in storage, handling and personal safety, and essential information on packing and labelling. This standard is under review.

2.2 Hexane is a hydrocarbon solvent generally manufactured in petroleum refineries. It is a volatile, flammable, and potentially hazardous chemical compound commonly used in various industrial processes, including the production of glues, adhesives, and solvents. With the evolution of industrial practices and technologies, ongoing research and advancements in risk assessment methodologies, new regulations regarding the use, storage, and handling of hexane there is need for review of safety standard on hexane.

2.3 In this context, it is proposed to carry out study along with the collection of data related to current and advance methodologies practiced by industries, and organizations involved in manufacturing, storage, transportation, and handling of hexane in compliance with the regulatory requirements.

3 Objective:

Extensive analysis and collection of information on nature of hazards associated with hexane, symptoms of toxicity, requirement of first aid on exposure, and the safety measures for handling, management (storage, and transportation) of hexane.

4 Scope

4.1 Literature Review

Conduct a comprehensive study and comparative analysis on the following data :

4.1.1 Regulatory Analysis:

4.1.1.1. Study of SoPs issued by local, national, and international regulations, international standards/publication, research paper to available govern and ensure the secure handling, storage, transportation, and proper disposal of hexane.

4.1.1.2 Information on material safety data sheets prepared by industries pan India involved in production, handling, storage and usage of hexane.

4.1.2 Chemical Risk Assessment:

4.1.2.1 Comprehensive data related to physical and chemical properties of hexane.

4.1.2.2 Extensive information on the various risks associated to the use and handling of hexane emphasizing crucial factors such as the level of toxicity (short term exposure limit (STEL), lethal concentration (LC₅₀), lethal Dose (LD₅₀), immediately dangerous to life and health(IDLH), threshold limit value (TLV), time weighted average (TWA)) flammability, explosiveness, reactivity, and the environmental impact of the product.

4.1.2.3 Detailed information on health hazards such as long term effect and short term effect, acute and chronic toxicity, local and systemic effect.

4.1.3 Work Safety Best Practices:

4.1.3.1 Compilation of information on best practices adopted by manufacturers, transporters, and other stakeholders including information on work environment monitoring to ensure worker safety while handling, transportation, disposal, and storage of hexane.

4.1.3.2 Specifics on personal protective equipment (PPE) requirements and usage, training programs, ergonomic considerations, and exposure monitoring for hexane.

4.1.3.3 Documentation of periodic training and education programs conducted by manufacturers to enhance safety awareness and knowledge among employees in the hexane industry.

4.1.3.4 Information on development of training materials, conduction of safety drills, and the impact of these programs on safety culture.

4.1.3.5 Comprehensive data on fire prevention and fire-fighting measures and procedures while handling hexane.

4.1.3.6 Information on physical and periodic medical examination of workers engaged in manufacturing and handling of hexane.

4.1.3.7 Information on first-aid measures, and medical treatment for workers in hexane industry.

4.1.4 Standard Operating Procedures (SOPs):

4.1.4.1 Documentation of SOPs for unloading and loading, storage, transportation in compliance with regulatory requirements for hexane.

4.1.4.2 Documentation of Standard Operating Procedures (SOPs) for the evaluation of ventilation systems, fire protection systems, and containment measures to prevent or minimize the release of hazardous substances for hexane.

4.1.4.3 Data on risk management and incident handling plan prepared by manufacturers for chemical spills, leaks, fires, explosions, and other emergencies related to hexane and their effectiveness.

4.1.5 Sustainability practices [energy consumption, renewable energy sources, sustainable practices, 3Rs (Reuse, Reduce and Recycle), waste management and disposal mechanisms.

4.2 Identification of manufacturing and consumer base, suppliers and vendors, and transporters involved in handling(storage, transportation) of hexane nationwide.

4.3 Gather the import and export data for hexane. Collate and study the information pertaining to technical regulation/ standard regulation applied in major countries concerned with respect to ensuring safety for hexane.

4.4 Visit to manufacturers, user industries or organization.

4.5 Prepare comprehensive analytical report documenting the research findings/ data collected as given in scope.

4.6 Share the comparative assessment of methodologies adopted to collect the data as specified in scope.

5 Research Methodology:

The project will involve the following research methodologies:

5.1 Literature Review:

5.1.1 Conduct an extensive literature review with respect to areas covered in scope.

5.1.2 Additionally, contact and collect data on the best practices followed from industry association, regulatory bodies, various export and import regulating agencies in India.

5.2 Visit to manufacturing units to witness and observe the manufacturing process, testing facilities, and storage and transportation facilities to have first-hand information .

5.3 Data Collection:

- ❖ Conduct Surveys or interviews with industry professionals to gather insights on industry specific remedial strategy covering points specified in scope.
- ❖ Review Tender agreements related to procurement of hexane floated by consumer industries with safety point of view.
- ❖ Structured Questionnaire for collection of feedback from manufacturers, transporters, importers/exporters, user interaction as per the points specified in scope. This can be done at initial stage.
- ❖ Conduct focused group discussion in a structured format with Safety Personnel, workers, and managers in the visits to be carried out in manufacturing units.

5.4 Analyse the findings collected as specified in scope.

6 Sampling Plan:

6.1 Visit to four manufacturing units (preferably 2 large and 2 MSMEs unless the manufacturing database indicates otherwise) visit to two consumer industries (preferably 1 large and 1 MSMEs unless the manufacturing database indicates otherwise). Collect data on points specified in scope. However the final sampling plan will be finalized on the basis data collected by the proposer.

7 Deliverables:

Considering the scope, the research shall be taken up by the proposer and final report shall be prepared incorporating the following information:

7.1 Submit comprehensive analytical report documenting the research findings/ data collected as given in scope (4).

7.2 Along with the final analytical report, append the survey formats and responses, , structured questionnaire, feedback forms collected after focussed interaction with managers and safety personnel's.

7.3 Report on comparative analysis of methodologies used.

8. Delivery Milestones and Review Process

Project Timeline- 3 months from the date of issue of sanction letter by BIS.

8.1 Review of the literatures, manufacturing and user industries, transporter database, collated feedback forms through surveys, structured questionnaire responses and existing stipulations, thereof – within 1 month from the date of issue of sanction letter by BIS.

8.2 Report of site visits and specific requirement as mentioned in scope and methodologies etc. – By end of 1 months from the date of issue of sanction letter by BIS.

8.3 Draft report covering all the aspects of the Scopes By end of 2.5 months from the date of issue of sanction letter by BIS.

8.4 Final report covering all the aspects of the Scope – By end of 3 months from the date of issue of sanction letter by BIS.

9 Support by BIS:

9.1 BIS standards are freely available in public domain.

9.2 BIS will provide access to available international standards required for the project as per requirement identified by the proposer.

9.3 Ms. Shubhanjali Umrao, Scientist B & Member Secretary, CHD 07 may be contacted for more clarification on the R&D project (chd07@bis.org.in)

NOTE: The proposer should collect and rely on the primary data to the extent possible and may also use peer reviewed publication data to support the finding, wherever necessary.