

TERMS OF REFERENCE FOR THE R&D PROJECT

[**Technical Committee:** Textile Speciality Chemicals and Dyestuffs Sectional Committee, TXD 07]

- 1. Title of the Project:** Development and validation of test method for determination of index ingredient from plant-based indigo and textiles dyed with plant-based indigo by using Carbon-14 (C-14) analysis.

2. Background

2.1 Indigo dye is widely used for dyeing fabrics, particularly in the production of denim. It imparts the characteristic deep blue color associated with jeans and denim garments. Indigo-dyed textiles are highly valued for their unique and rich color that develops through repeated dyeing and oxidation processes. Plant based indigo is the most important dye for producing blue colour, a primary colour in textiles dyed with natural dyes.

2.2 BIS has published 3 standards on indigo identification and test method i.e. IS 17084 : 2019 Textile dyestuffs — Natural indigo — Identification and IS 11678 : 2021 Textile dyestuffs — Method for determination of strength of indigo on dyed textiles (First Revision), IS 11636 : 2022, Textile dyestuffs — Methods for determination of strength of indigo in substance (First Revision).

2.3 Earlier an ISO draft was proposed to ISO/TC 38 on ‘Test protocol for identification of natural dye and naturally dyed textiles with indigo’. The draft specified the determination of index ingredient from textiles dyed with plant-based indigo using HPLC (chromatographic) method. The proposal was not accepted because, clear distinction was not observed in the chromatograms through the aforementioned test methods. The technical committee, TXD 07 has recommended for C-14 analysis for identification of plant-based Indigo and plant-based indigo dyed textiles.

2.4 C-14 analysis, a well-established technique for dating organic materials based on the radioactive decay of carbon-14 isotopes and to report percentage ‘biobased carbon content’ to reflect the biomass-based portion of the dyes. Natural indigo dye is derived from plants, while synthetic indigo is typically derived from petrochemical sources. Though both have similar chemical entity as colouring matter, Natural indigo obtained from plants will have a distinct isotopic signature compared to synthetic indigo derived from non-organic sources.

2.5 The results obtained from the study will serve as the basis for development of new test method for determination of index ingredient from plant based indigo and textiles dyed with plant based indigo by using Carbon-14 (C-14) analysis and formulating the ISO NWIP draft with the novel method.

3. Scope

- Study and analyze the existing literature which include but not restricted to the following:-
 - National/ International Standards on the subject and related subjects
 - Standard operating procedures (SOPs)/guidelines of laboratories
 - Journals and research papers

- iv) Any study conducted by other organizations
 - v) Any other relevant published information on the subject
- b) Collect the database of testing infrastructure equipped with C-14 test facilities and users in the country.
 - c) Undertake 2 visits to laboratories equipped with C-14 analysis testing facility to collect the information including but not restricted to the following: -
 - i) Principle of the test method
 - ii) Procedures for specimen preparation, stock solution/standard preparation.
 - iii) Any additional preparatory processes required.
 - iv) Test conditions
 - v) List of apparatus used during the test
 - vi) Procedure/detailed method
 - vii) Reagents, chemicals or any other auxiliaries
 - viii) Specific tests conducted as part of the method
 - ix) Test result representation, including chromatograms, calibration curves, or visual observations.
 - x) Expression or calculation of the obtained results.
 - xi) Laboratory Standard Operating Procedure (SOP) for the test method
 - xii) Focused group discussion on testing related issues, challenges being faced and suggestion
 - d) The feedback from other laboratories where visit is not carried out shall be obtained through structured questionnaire including the above details.
 - e) Purchase/collect a total of 09 samples of different known impurity and carry out tests and interlaboratory validation in 2 NABL accredited lab or equivalent lab equipped with the necessary capabilities as per the detailed method of C-14 analysis for determination of index ingredient from plant-based Indigo and plant-based Indigo dyed textiles.
 - f) Prepare a comprehensive project report covering the all the information mentioned under the scope of the R & D Project.

4. Expected Deliverables

- a) Comprehensive report in soft/hard form covering all the aspects detailed in the scope of the R & D project.
- b) Questionnaire feedback, reports of visit, test results, focussed group discussion report, other relevant documents and information shall be appended to the project report.

5. Research Methodology:

- a) Collect and analyse the data/information as specified in the scope [4 (a) to (b)].
- b) Visit labs and collect data/information as specified in the scope [4 (c) and 4 (d)].
- c) Prepare technical data, test the samples and in the scope [4 (e)].
- d) Analysis the data/information and prepare a comprehensive project report.

6. Requirement for the CVs:

Graduate in Textile Technology/Textile Engineering/ Textile Chemistry/Fiber Science & Technology, Chemical Engineering/Chemistry/Applied Chemistry.

7. Timeline and Method of progress review:

The duration of the project is 180 days from the date of the award of the project. The stagewise indicative timelines are as follows:

Time line	Method of progress
0 to 30 days	Literature review, desktop study, collection of data and information Note — The plan for visit and collection/purchase of samples shall be discussed and finalized with nodal officer after literature survey and desktop research.
31 to 60 days	Visit to testing lab Collection of Technical data/information on C-14 analysis
61 to 150 days	Testing of samples and completion of test report Preparation and submission of draft report to BIS
151 to 180 days	Consolidation of data, Submission of final report of the project.

8. Support BIS will provide: -

- a) All the relevant Indian Standards/ISO Standards or any other standards required during the project will be provided by BIS.
- b) Facilitate/introduction of the project leader/organization to relevant Industry and industry association, testing lab, institute, academia, user, regulator/ministries.
- c) Facilitate testing of samples in BIS Lab/BIS Recognized Lab.

9. Nodal Point

In case any queries/clarification, Shri Himanshu Shukla, Sc-B & Member Secretary, TXD 07 may be contacted on txd@bis.gov.in.