iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH
IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 13 Issue: IV Month of publication: April 2025

DOI: https://doi.org/10.22214/ijraset.2025.68878

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 13 Issue IV Apr 2025- Available at www.ijraset.com

Technology Development for Soap, Detergent and its Raw Material Testing (Part-I A: Portable Kit used for Quality Control of Soap & Detergent)

Mr. Swanand Kalambe[1], Dr. R.B. Chavan[2], Dr. S.N. Naik[3], Dr. Rajendra Prasad[4] , Mr. Vikas Choudhary[5], Dr. Aprajita Vardhan[6]
[1, 2, 5, 6]Mahatma Gandhi Institute for Rural Industrialization, MGIRI Wardha
[2, 3, 4] Indian Institute of Technology, Delhi

Abstract: In rural areas, Khadi and Village Industries (KVI) units and small-scale handmade soap manufacturers commonly utilize raw materials such as oils, fatty acid distillate, acid slurry, caustic lye, sodium silicate, and soda ash for the production of soaps and detergents. To uphold product standards and customer confidence, it is crucial to guarantee the quality and uniformity of both raw materials and completed goods. However, the lack of affordable, accessible, and user-friendly testing facilities often leads to quality control issues. In response to this need, a practical and cost-effective "Testing Kit for Soap, Detergent and its Raw Materials" was developed during the 2008–09 study. This kit was designed to support KVI units and grassroots producers by enabling in-house quality assessment of raw materials and finished goods. The kit includes simplified analytical methods suitable for field-level application without requiring sophisticated laboratory infrastructure. This paper presents the development of a low-cost, user-friendly testing kit for evaluating quality parameters of soap, detergent, and raw materials, intended for application in Khadi and Village Industries (KVI) sectors and small-scale manufacturers. The design of the kit is simplified for non-laboratory rural settings and is based on standardised test protocols described by the Bureau of Indian Standards (BIS) [1]– [5].

I. INTRODUCTION

Soap and detergent manufacturing in rural India faces significant challenges in quality control due to lack of infrastructure and testing facilities. Critical characteristics including total fatty matter (TFM), moisture content, free alkali, active detergent concentration, and surface tension are defined by the Indian Standards for soap and detergents [1]– [4]002E However, most rural units are unable to access sophisticated laboratories or afford BIS-approved testing agencies. To bridge this gap, a portable and low-cost testing kit was conceptualized, developed, and distributed via the Mahatma Gandhi Institute for Rural Industrialization (MGIRI), Wardha, and the Khadi and Village Industries Commission (KVIC). [9]

II. BACKGROUND

Soaps and detergents have become essential commodities in modern life, primarily due to their indispensable role in personal and household hygiene. A significant portion of soap and detergent production in India is carried out by cottage and small-scale units, particularly in rural areas, to cater to the demands of local markets. These units typically utilize raw materials such as vegetable oils, fatty acid distillates, acid slurry, caustic lye, sodium silicate, and soda ash in their formulations. However, the technologies employed by many of these small-scale manufacturers are outdated and lack systematic quality control mechanisms. As a result, their products often fail to match the quality standards of those produced by large-scale industries and multinational corporations. The competitiveness and viability of rural soap and detergent producers are seriously threatened by this quality disparity. The Mahatma Gandhi Institute for Rural Industrialization's Chemical Industries Division recognized this problem and set out to create a useful, user-friendly testing equipment especially for soap, detergent, and their basic materials. The goal of this project was to enable small-scale manufacturers to evaluate the quality of their raw materials and final goods on-site, without the need for sophisticated laboratory equipment.

The kit supports the long-term sustainability of village-based manufacturing units, boosts consumer confidence, and encourages quality assurance.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 13 Issue IV Apr 2025- Available at www.ijraset.com

III. OBJECTIVE

This study's main goal was to create and offer a field-level, reasonably priced solution for quality assurance in the production of soap and detergent, with a focus on cottage and small businesses. The testing kit was designed to empower these producers with the capability to evaluate the quality of both raw materials and final products without relying on sophisticated laboratory infrastructure.
The kit enables testing of critical quality parameters for various categories of soap and detergent products, as outlined below:

A. For Detergent Powder and Detergent Cake

1) Active Matter: Measures the effective cleansing component of the detergent, indicating its cleaning efficiency.
2) Surface Tension: Assesses the wetting ability of water containing detergent, which is crucial for effective cleaning.
3) Foam Height: Evaluates the detergent's foaming characteristics, which influence consumer perception and product performance.
4) pH Value: Indicates the alkalinity of the detergent, which affects both cleaning performance and fabric compatibility.
5) Percent Moisture: Determines the water content in the product, which influences shelf life and stability.

B. For Toilet Soap and Laundry Soap

1) Total Fatty Matter (TFM): Indicates the total amount of fatty substances in the soap, a key determinant of its quality and skin-friendliness.
2) Free Alkalinity and Free Fatty Acidity: Measures excess alkali or free acids, which can affect the safety and mildness of the soap.
3) pH Value: Reflects the alkalinity of the soap, impacting its mildness on the skin.
4) Percent Moisture: Determines the moisture content, which can influence the hardness, usage rate, and storage stability of the soap.
5) Lather/Foam Generation: Assesses the soap's ability to produce foam, which is often linked to user satisfaction.

This set of parameters provides a comprehensive assessment of product quality, supporting rural and small-scale manufacturers in maintaining consistent production standards.

IV. LITERATURE REVIEW AND STANDARD BACKGROUND

The BIS standards for soaps and detergents are well-established: IS 286:1978 defines quality parameters for toilet soaps [3], IS 539:1960 for laundry soaps [4], and IS 4955:2001 covers synthetic detergent powders and bars [2]. Testing protocols for surface tension, alkalinity, and active detergent content are detailed in IS 13498:2002 and IS 4955:1982 [1], [5]. Academic institutions like LIT Nagpur have also developed empirical methods and internal evaluation protocols for these parameters, assisting in earlier validation studies [8]. Tripathi [6] and Patel and Bhosale [7] have documented practical challenges in adopting standard methods in field conditions.

V. RESEARCH METHODOLOGY

This study aimed to develop and validate simplified test methods suitable for field-level quality analysis of soap and detergent products. One of the critical parameters included in the testing kit is the determination of Active Matter in detergent powder or detergent cake, which directly reflects the detergent's cleaning efficiency.

A. Determination of Active Matter in Detergents

1) *Apparatus*
   - Measuring flask (stoppered)
   - 10 mL pipette
   - 100 mL volumetric flask
   - Digital weighing balance

2) *Reagents*
   - Chloroform (chemically pure)
   - Methylene blue solution (0.005%)
   - Benzethonium chloride solution (0.004 M)

3) Procedure

a) Preparation of Sample Solution

- Accurately weigh 1.0 g of detergent sample using a digital weighing balance.
- Pour distilled water into a 50 mL beaker and dissolve the sample.
- Quantitatively pour the solution into a 100 mL volumetric flask with a glass stopper, then top it off with water to reach the desired volume.

b) Estimation of Active Matter:

- Using a glass stopper, pipette 10 mL of the sample solution into a 100 mL graduated cylinder.
- Fill the cylinder with 25 mL of methylene blue solution and 15 mL of chloroform.
- Give the mixture a good shake and let the layers come apart. The layer of chloroform should have a blue or greenish-blue appearance.
- Using a pipette, gradually add the benzethonium chloride solution, first in 0.2 mL increments and then dropwise.
- Stop the cylinder after every addition, give it a good shake, and let the phases separate.
- The chloroform layer stays blue or greenish-blue at first.
- Near the endpoint, the blue colour starts migrating to the aqueous layer.
- Once the blue colour intensity in both layers is equal, note the volume of benzethonium chloride solution that was added.

Calculation:

The active matter content is calculated using the formula prescribed in Indian Standards:

As per IS 4955:1982:

$$\text{Active Matter \% by mass} = \frac{348XV'XT'X1}{M'} \quad \text{(As per IS 4955:1982)}$$

As per IS 4955:2001 (updated molecular weight):

$$\text{Active Matter \% by mass} = \frac{342XV'XT'X1}{M'} \quad \text{(As per IS 4955:2001)}$$

Where:

- 348/342 = Molecular weight of sodium alkyl benzene sulphonate
- V' = Volume (in mL) of benzethonium chloride used
- T' = Molarity of benzethonium chloride solution
- M' = Mass (in grams) of the detergent sample taken
- 1 = Dilution factor

This simplified method has been validated and included in the testing kit for use by rural and small-scale detergent manufacturers. The calculations are consistent with standard BIS guidelines, ensuring reliable quality assessment at the grassroots level.

4) Active Matter Quality Standards for Detergent Grades

To facilitate the interpretation of test results, the following specifications for active matter content in detergent products are provided as a guideline. These benchmarks help categorize the quality of detergent powders and cakes into distinct grades based on their cleansing efficiency: [2] [5]

Grade	Active Matter (% by Mass)	Quality Description
Grade 1	More than 19%	Superior quality
Grade 2	16% to 19%	Good quality
Grade 3	12% to 16%	Moderate quality
Grade 4	10% to 12%	Basic/lower-end quality

These specifications are aligned with commonly accepted industry and BIS standards, and serve as reference points for rural manufacturers aiming to benchmark their products. The field-level determination of active matter using the developed kit enables producers to classify and improve their detergent formulations accordingly.

B. Determination of Surface Tension in Detergent Solutions

Surface tension is an important indicator of the wetting ability of a detergent solution. Lower surface tension enhances the penetration of water into fabrics and soils, thereby improving the cleaning efficiency.[5]

1) Apparatus

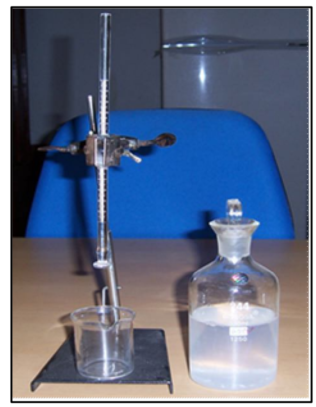
- Stalagnometer
- 50 mL beaker
- Retort stand
- Stoppered bottle (250 mL)
- Digital weighing balance
- Vacuum suction rubber bulb

2) Procedure

a) Preparation of 0.1% Detergent Solution

- Weigh exactly 0.1 g of detergent sample using a digital weighing balance.
- Transfer the sample to a 250 mL stoppered bottle.
- Add 100 mL of distilled water and mix thoroughly to obtain a 0.1% detergent solution.

b) Surface Tension Measurement Using Stalagnometer:



- Shake the prepared solution 25 times in a circular motion inside the stoppered bottle to ensure uniform dispersion.
- Pour the 0.1% detergent solution into a 50 mL beaker.
- Place the beaker beneath a clean, dry stalagnometer fixed vertically on a stand.
- Using a vacuum suction rubber bulb, draw the detergent solution up to the upper mark of the stalagnometer.
- Allow the solution to fall dropwise under gravity and count the number of drops (n_1) required for the liquid to fall from the upper to the lower mark.
- Repeat the procedure using distilled water and record the number of drops (n_2).

3) Calculation

$$g_1 = \left(\frac{n_2}{n_1}\right) \times g_2$$

Where:

- g_1 = Surface tension of the detergent solution (dynes/cm)
- g_2 = Surface tension of distilled water (71.18 dynes/cm at room temperature)
- n_1 = Number of drops of detergent solution
- n_2 = Number of drops of distilled water

4) Interpretation of Results

The following classification can be used as a guideline to assess detergent quality based on the surface tension of a 0.1% solution:

Grade	Surface Tension (dynes/cm)	Quality Description
A	Below 30	Excellent
B	30 – 35	Good
C	Above 40	Poor

This method is simple, rapid, and suitable for field-level evaluation using the developed testing kit, supporting consistent quality control for rural and small-scale detergent manufacturers.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 13 Issue IV Apr 2025- Available at www.ijraset.com

C. Determination of Foam Height (Lather Test)

(Applicable for Detergent Powders, Laundry Soaps, and Toilet Soaps)

Foam generation and its stability are key performance indicators of soaps and detergents. While foam itself does not contribute directly to cleaning, its presence is psychologically associated with efficacy by users and it plays a role in soil suspension and ease of removal.

a) Apparatus

- Foam height measuring cylinder (1,000 mL capacity)
- Stoppered bottle
- Digital weighing balance

b) Procedure

A. Making the 0.5% Solution:
1. Weigh 0.5 g of the detergent or soap sample precisely.
2. Pour 100 mL of distilled water into a sterile 100 mL stoppered bottle.
3. To guarantee adequate dispersion, give the solution a vigorous 25-time circular shake.

B. Measurement of Foam Height:
1. Fill a 1,000 mL graduated cylinder with a stopper with 100 mL of the 0.5% solution.
2. Within 30 seconds, rotate the cylinder 30 times up and down.
3. Set the cylinder on a level surface right away, and at 0 minutes, note the amount of foam (in millilitres) above the liquid level.
4. After fifteen minutes of leaving the cylinder alone,

This method provides a visual and quantitative assessment of foam-generating capacity and foam retention over time, which reflects the surface activity and formulation quality of the sample.

c) Foam Height–Based Classification of Detergent/Soap Quality

Based on empirical data collected from LIT, Nagpur)

Grade	Time (min)	Foam Height (mL)	Quality Description
Grade 1	0–15	500 and above	Excellent foaming
Grade 2	0–15	350 – 500	Good foaming

Foam height serves as an indicator of the foaming characteristics and formulation performance, especially for field-level quality assessment where rapid evaluation is essential.

D. Determination of pH Value

(Applicable to Detergent Powders and Soaps)

The pH value of soaps and detergents reflects their alkalinity or acidity and serves as an important parameter for assessing user safety and product stability. Excessive alkalinity may cause skin irritation or degradation of fabric.[1]

1) pH Determination for Detergent

a) Dissolve 0.1 g of detergent in 100 mL of distilled water to get a 0.1% solution.
b) Insert a pH indicator strip into the mixture, then check the colour shift that occurs against the pH scale on the strip's box.
c) A desirable pH range for detergent solutions is **9 to 11**.

2) pH Determination for Toilet Soap:

a) Wet a strip of filter paper with distilled water and gently rub it on the surface of the soap. Alternatively: Dip the pH paper into a 0.1% soap solution prepared as above.
b) Match the resulting colour with the reference scale to determine the pH.
c) The acceptable pH range for toilet soaps is **9 to 10**.

3) Interpretation

- A pH above **11** is generally considered **undesirable**, as it indicates excessive free alkali, which can be harsh to skin and fabrics. [11]

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 13 Issue IV Apr 2025- Available at www.ijraset.com

E. Determination of Percent Moisture

(Applicable to Detergents and Soaps)

Moisture content in soaps and detergents affects shelf life, texture, and stability. Accurate determination of moisture is essential for standardization and quality control.[3]

Note: A stable electric supply is required for this procedure.

1) Apparatus

- Spot lamp (60 W, Philips or equivalent)
- 250 mL beaker (approx. 9.5 cm height × 7 cm diameter)
- Digital weighing balance
- Desiccator

2) Procedure

a) Clean and dry a 250 mL beaker thoroughly.
b) Weigh approximately 5 g of the soap or detergent sample into the beaker and record the total weight as W_1.
c) Insert the spot lamp directly into the mouth of the beaker and switch it on.
d) Heat continuously for 2.5 hours under the lamp.
e) After heating, place the beaker in a desiccator for 15 minutes to cool, then weigh and record the weight.
f) Repeat the heating and cooling cycle in 15-minute increments until a constant weight is obtained. Record this final weight as W_2.

3) Calculation

$$\text{Moisture Content (\%)} = \frac{W_1 - W_2}{\text{Weight of Sample}} \times 100$$

4) Guidelines for Moisture Content

Based on data collected from LIT, Nagpur)

Product	Acceptable Moisture Range (%)
Detergent	10 – 16
Soap	6 – 10

Maintaining moisture within the recommended range ensures product integrity and prevents microbial growth or spoilage during storage.

F. Determination of Total Fatty Matter (TFM)

(Applicable to Toilet Soaps and Laundry Soaps)

One important metric for assessing the quality of soap is total fatty matter (TFM). A soap sample's total amount of fatty compounds, mostly fatty acids, in both saponified and unsaponified forms is referred to by this term. Better cleaning qualities and tenderness on the skin are generally indicated by high TFM scores. [3] [6]

1) Apparatus Required

- Beaker – 250 mL
- Water bath or steam bath
- Digital weighing balance
- Stand and glass stirring rod
- Spot lamp

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 13 Issue IV Apr 2025- Available at www.ijraset.com

2) Reagents

1. 1:1 Sulphuric acid (H_2SO_4)
2. Methyl orange indicator solution
3. Beeswax (10 g)

3) Procedure

1. In a 250 mL beaker set over a steam bath, warm 100 mL of distilled water.
2. Accurately **weigh 10 g of soap chips** and dissolve them in the warm water with constant stirring.
3. To the solution, add two to four drops of methyl orange indicator.
4. Carefully add **1:1 sulphuric acid solution dropwise** until the solution turns orange, indicating complete neutralization.
5. Continue heating on the steam bath to allow the **fatty acids to separate and float to the top**.
6. Once separation is evident, add **10 g of beeswax** to the beaker and allow it to **fully melt and mix** with the fatty acids.
7. Stir the contents thoroughly to form a homogeneous solution.
8. Remove the beaker from the bath and let it stand **overnight at room temperature**.
9. The following day, a **solid cake** (a mixture of fatty acids and wax) will be observed at the surface.
10. **Gently dislodge** the solid mass using a glass rod, ensuring all adhering material is collected.
11. Place the solid cake on **absorbent tissue paper** and press gently to remove excess moisture.
12. Allow the cake to **dry completely under a fan**, then weigh it accurately.

4) Calculation

$$\text{Total Fatty Matter (\%)} = (\text{Weight of cake} - 10) \times 10$$

Note: 10 g of beeswax was added to the mixture and is subtracted in the final calculation.

5) TFM Standards for Soap Grades
(As per BIS Guidelines; ±3% variance acceptable in field kit method)

Toilet Soap

Grade	Minimum TFM (%)
Grade 1	≥ 76
Grade 2	70 – 76
Grade 3	60 – 70

Laundry Soap

Type	Grade 1	Grade 2
Type 1 Soap	≥ 62%	-
Type 2 Soap	≥ 45%	≥ 35%

This procedure provides a low-cost, field-appropriate approach to estimate TFM, making it particularly suitable for rural and small-scale manufacturers. While the accuracy may differ slightly from laboratory-grade methods, the kit-based technique is a practical compromise to ensure quality assurance at the grassroots level.

G. Determination of Free Caustic Alkalinity and Free Fatty Acid (Applicable to Toilet Soaps and Laundry Soaps)

The presence of free caustic alkali and free fatty acids in soap products serves as an indicator of both product quality and safety. Excess free alkali may cause skin irritation, while the presence of free fatty acid reflects the degree of soap hydrolysis or incomplete saponification.[1]

Apparatus Required:

- Water bath (80°C)
- 250 mL conical flask
- Glass rod
- Digital weighing balance
- Pipettes (1 mL and 10 mL capacity)

Reagents:

- Ethyl alcohol (C_2H_5OH)
- Phenolphthalein indicator
- 0.1 N Sulphuric acid (H_2SO_4)
- 0.1 N Sodium hydroxide (NaOH)

1) Determination of Free Caustic Alkali

Note: If no pink colour develops after addition of phenolphthalein, proceed to Section (b) for free fatty acid determination.

Procedure:

- Weigh 10 g of the soap sample precisely and transfer it to a 250 mL conical flask.
- Include two drops of phenolphthalein indicator in 100 milliliters of ethyl alcohol.
- Use 0.1 N NaOH to titrate the solution until a light pink tint develops.
- Make a new 100 mL of neutralized ethyl alcohol and discard the titrated solution.
- Add this to the same flask containing the weighed sample.
- Warm the mixture on a steam bath at 80°C with continuous stirring until the soap fully dissolves.
- Titrate with 0.1 N H_2SO_4 after adding two drops of phenolphthalein until the pink hue is gone.

Calculation:

$$\text{Free Caustic Alkali (as NaOH)\%} = \frac{4 \times V \times N}{M}$$

$$\text{Free Caustic Alkali (as KOH)\%} = \frac{5.61 \times V \times N}{M}$$

$$\text{Free Caustic Alkali (as K}_2\text{O)\%} = \frac{4.71 \times V \times N}{M}$$

Where:

- V = Volume of 0.1 N H_2SO_4 used (in mL)
- N= Normality of H_2SO_4
- M= Mass of soap sample taken (g)
- Constants are equivalent weights of respective bases

2) Determination of Free Fatty Acid (Optional)

Procedure:

1. Weigh 10 g of the soap sample precisely and transfer it to a 250 mL beaker.
2. Add two drops of phenolphthalein indicator to 100 millilitres of neutralised ethyl alcohol.
3. Put the beaker on a steam bath after adding this to the soap sample.
4. Gently stir the mixture and shake it often until it dissolves completely.
5. Include a few more phenolphthalein drops.
6. Use 0.1 N NaOH to titrate the solution until it becomes slightly pink.

Calculation

$$\text{Free Fatty Acid (as Oleic Acid)\%} = \frac{28.25 \times V \times N}{M}$$

Where:

- 28.25 = Gram equivalent of oleic acid
- V = Volume of 0.1 N NaOH used (mL)
- N = Normality of NaOH
- M = Mass of soap sample (g)

Free Caustic Alkali Standards

(Maximum allowable limits as per BIS guidelines)

Product	Grade 1	Grade 2	Grade 3
Toilet Soap (%)	0.05 (max)	0.05 (max)	0.05 (max)
Laundry Soap (%)	0.20 (max)	0.20 (max)	—

This dual approach to measuring alkalinity and acidity in soap samples ensures compliance with BIS norms while identifying over-saponification or hydrolytic degradation, which can affect the usability and safety of the product.

All reagents used were non-toxic and suited for ambient use. The procedure was field-tested with 16 KVIC training centers and later evaluated by MGIRI [9]

VI. RESULTS AND DISCUSSION

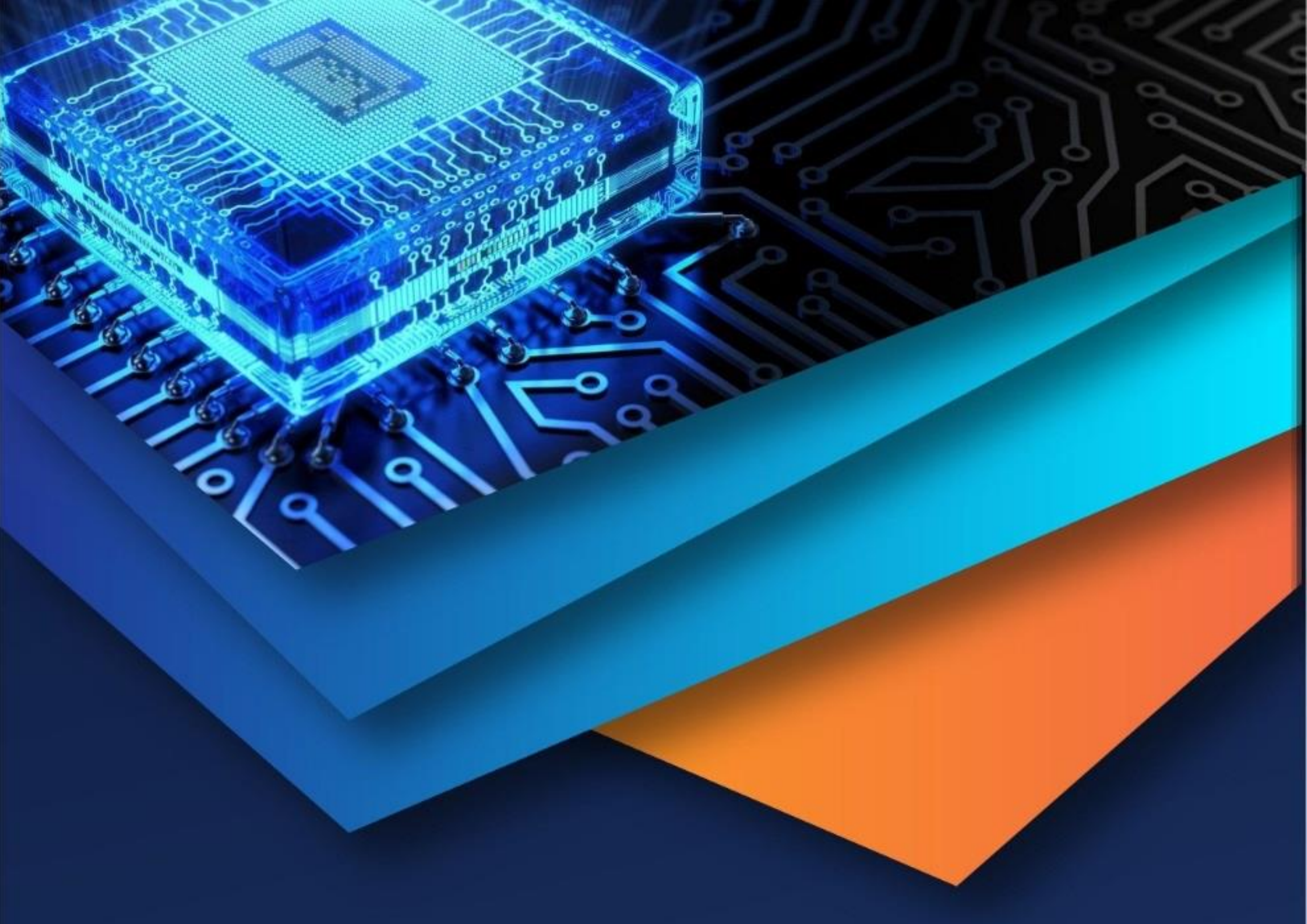
The field-level data collected by LIT Nagpur showed that most small-scale units produced soaps with TFM ranging from 52–60%, meeting Grade 2–3 BIS standards [8]. Kits accurately detected excessive free alkali in handmade detergent powders and soap samples, enabling on-site correction [7]. Moreover, the surface tension of detergent solutions was found to correlate well with the presence of synthetic surfactants, aligning with IS 13498:2002 [5].

VII. CONCLUSION

The Soap and Detergent Testing Kit represents a critical step in democratizing quality control for rural KVI units. Its design aligns with Indian standards [1][5] but removes the complexity of traditional lab-based analysis. The tool empowers small manufacturers to validate their product quality and meet consumer expectations.

REFERENCES

[1] Bureau of Indian Standards, IS 4955:1982 – Methods for Testing of Synthetic Detergents. New Delhi: BIS, 1982.
[2] Bureau of Indian Standards, IS 4955:2001 – Methods for Testing of Synthetic Detergents (Revised). New Delhi: BIS, 2001.
[3] Bureau of Indian Standards, IS 286:1978 – Specification for Toilet Soap (Second Revision). New Delhi: BIS, 1978.
[4] Bureau of Indian Standards, IS 539:1960 – Specification for Laundry Soap. New Delhi: BIS, 1960.
[5] Bureau of Indian Standards, IS 13498:2002 – Surface Tension Measurement Methods. New Delhi: BIS, 2002.
[6] G. N. Tripathi, Soap and Detergent Testing Manual. New Delhi: Laxmi Publications, 2005.
[7] T. S. Patel and S. A. Bhosale, "Development of a low-cost detergent quality kit for cottage industries," Indian J. Chem. Technol., vol. 15, no. 3, pp. 234–239, May 2008.
[8] LIT Nagpur, "Empirical test data for soap and detergent standards – Internal report," Dept. of Oil and Fats Technology, 2007.
[9] MGIRI, Wardha, "Field dissemination report: Soap & detergent testing kit," MGIRI Technical Bulletin, 2009.
[10] H. F. Launer, "Determination of the pH value of papers," J. Res. Natl. Bur. Stand., vol. 22, no. RP1205, May 1939.
[11] J. C. Harries, Detergency: Evolution and Testing. New York: Interscience Publishers, 1954.
[12] E. G. Thomson and J. W. McCutcheon, Analytical Methods for Soap and Detergent Industries. New York: Macnair-Dorland Co., 1949.
[13] A. Charanwar, Polymeric Surfactant Based on Carbohydrate Polymer (M.Tech. thesis), Dept. of Oil Technology, LIT, Nagpur, 2008.



10.22214/IJRASET

INDEX COPERNICUS

45.98

IMPACT FACTOR: 7.129

TOGETHER WE REACH THE GOAL

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY