

RESEARCH & DEVELOPMENT ACTIVITIES

As a policy matter, the aim for NITRA's research and development activities is to help the industry. So, at NITRA, ideas for most of the R & D projects are conceived only after interaction with the industry. Need based projects are earmarked for carrying out research and special emphasis is given to those projects which have industry acceptance as well as commercial viability.

In the year 2019-20, NITRA worked on ten projects. Out of which four have been successfully completed during the period whilst work is in progress for the six projects.

Work done in the area of R&D during the year 2019-2020 is categorized as below:

1. GOVERNMENT SPONSORED PROJECTS

1.1 Completed projects

- (i) **Project title** : Development of protective work wear for cement porters
(Sponsored by Ministry of Textiles, Govt. of India)
- Objectives** :
- To determine the magnitude of occupational health hazards among cement porters
 - To design and standardize dustproof and comfortable material such as gloves, socks and workwear for cement porters which can suit the climatic and working conditions
 - To evaluate effectiveness of the developed material in actual practice and standardization of test methods
- Research Outcome** :
- Fabric samples were developed after intensive survey of cement user/ manufacturers
 - Fabric dust proof property analyzer has been fabricated and a patent has been filed
 - Cement work wear is developed and commercialized
 - Project is completed and technology has been transferred to M/s. Arvind Ltd., Ahmedabad.
 - Brief details of experimental work carried out are given here:

Under "Development of protective work wear for cement porters" project, four fabric samples coded as 'A', 'B', 'C', and 'D' were developed and tested for various properties including cement dust resistance property. The results of this study are shown in the Table-1. Out of four fabric samples, Sample C found to be better than others as it has low lower mass, higher tear and tensile strength, lower UV exposure effect, better water vapour permeability than others. Other properties like air permeability, acid and alkali resistant of all the samples were similar. The dust resistance property is shown in the Fig.-1. This test is

carried out on NITRA's developed Fabric dust resistance tester (Fig.2). It is explicit from the figure that dust resistance property of Sample-C is better than other three samples at different air jet pressure.

Table 1 : Results of various properties

| Property | Sample A | Sample B | Sample C | Sample D |
|---|----------------------------|----------------------------|------------------------|--------------|
| Mass, g/m ² | 185 | 182 | 135 | 182 |
| Fabric Thickness (5 kPa), mm | 0.40 | 0.44 | 0.38 | 0.32 |
| Tear strength, Newton Warp wise Weft wise | 52 48 | 56 49 | 63 53 | 19.5 18.5 |
| Tensile Strength, Newton Warp wise Weft wise | 428.9 527.8 | 431.8 551.2 | 653 478 | 563 435 |
| Tensile strength after UV exposure-60 hrs, Newton Warp wise Weft wise | 380.7 269.3 | 389.5 242.2 | 547 283 | 221 202 |
| Water Vapour Permeability, mg/cm ² /hour | 5.16 | 4.58 | 5.74 | 5.53 |
| Air Permeability, cc/sec/cm ² | 0 | 0 | 0 | 0 |
| Taber Abrasion Resistance, Load: 250 grams, CS- 10, No. of cycles till the first thread breaks | 100 | 300 | ≥1000 | ≥1000 |
| Chemical resistance test i) NaOH (10% Con.) - Penetration, % - Repellency, % ii) H ₂ SO ₄ (30% Con.) - Penetration, % - Repellency, % | 0 92.7 0 97.3 | 0 96.6 0 93.5 | 0 92 0 96 | 0 96 |

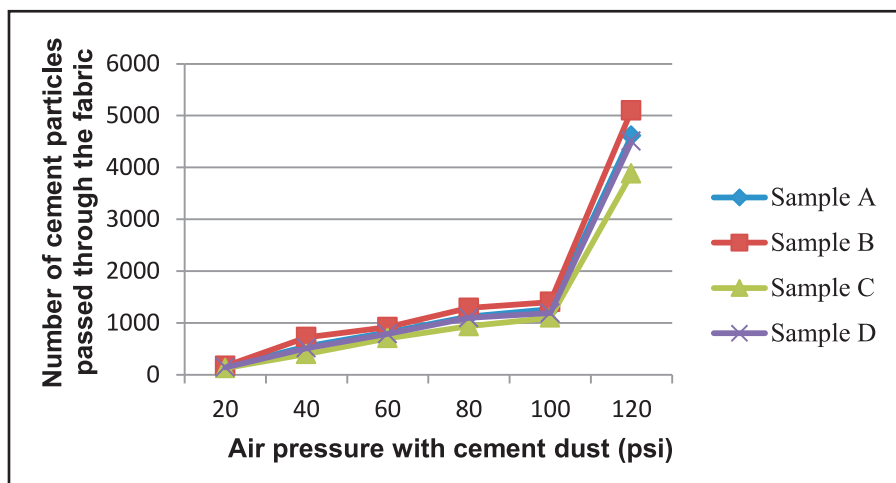


Fig. 1 : Dust resistance property of fabric samples



Fig.2: NITRA - Fabric dust resistance tester
(Indian Patent application no. 201711002704)

- (ii) **Project title** : Development of multi layered flame & thermal resistant fabric for fire-fighter clothing (Sponsored by Ministry of Textiles, Govt. of India)
- Objectives** :
- To study existing fire fighter clothing/suit being used in India for their suitability related to safety and other physiochemical properties
 - To study fire fighter/clothing suit used in developed country for their safety and physiochemical properties
 - To identify gaps in the existing fire fighter suits being used in Indian fire fighters in comparison to fire fighter suits of developed country
 - Development of multilayered fabrics using various weaves structure, fibres composition and finishing applications in the manufacturing of fibre fighter suit

- To evaluate multilayered fabrics for its performance for safety and other physiochemical properties as per standard
- Development of fire fighter clothing/suit

Research Outcome :

- Fire fighter suits were procured and their physiochemical properties were evaluated
Gaps were identified
- Multilayered fabric for fire fighter suit is developed
- Evaluation of developed material is carried out
- Provisional patent has been filed for thermal layer
- Fire fighter suit is fabricated
- Project is completed and technology has been transferred to M/s. Arvind Ltd. and M/s. Aeronav Industrial Safety Appliances
- Brief details of experimental work carried out are given here:

NITRA has developed fire fighter suit (Fig.3) under this project. A new type of thermal layer (Patent application no. 201711010197 dated 23.03.2017) was used for the development of this fire fighter suit. The developed fire fighter suit meets the requirements of EN 469 and IS 16890 as shown in the following Table-2.

Table 2: Performance of fire fighter suit developed by NITRA

| S.No. | Properties | Requirement | Results | Observation |
|-------|---|---|---|-------------|
| 1. | Flame resistance as per IS 15758 :Protection against heat & flame- Method of test for limited flame spread | i) No Specimen shall have flaming to top or either side edge ii) No specimen shall have hole formation in any layer iii) No specimen shall have flaming or molten debris iv) The mean value of after flame time shall be ≤ 2 sec. v) The mean value of afterglow time shall be ≤ 2 sec. | i) Nil ii) Nil iii) No flaming/ molten debris iv) Nil v) Nil | Pass |
| 2. | Heat Transfer (Flame Exposure) as per IS 15758 (Part 1) | Heat transmission index (I_Q) of $I_{Q.24} \geq 13$ $(I_{Q.24} - I_{Q.12}) \geq 4$ | T12= 8.2 T24=13.7 T24-T12 = 5.5 | Pass |

| S.No. | Properties | Requirement | Results | Observation |
|-------|---|---|---|-------------|
| 3. | Heat Transfer (Radiant Exposure) as per IS 15758 (Part 2) Heat flux: 40 kW/m ² | i) Mean Heat Transmission Index (HTI ₂₄) t ₂ ≥ 22sec ii) (t ₂ – t ₁)HTI ₂₄ -HTI ₁₂ ≥ 6sec | i) (HTI ₂₄) t ₂ = 24.3sec HTI ₁₂ = 15.3 sec ii) (t ₂ – t ₁) or HTI ₂₄ -HTI ₁₂ = 9 sec Qc = 7.392 sec TF= 0.184 | Pass |
| 4. | Residual Strength of material when exposed to 10 kW/m ² (IS 15758 part-2) radiant heat As per IS 1969 (Part 1) | Tensile strength ≥ 450 N | >450 N in both direction | Pass |
| 5. | Heat Resistance as per ISO 17493 at temperature 180±5°C using hot air circulating oven | shall not melt, drip, separate, or ignite, & shall not shrink more than 5% in both directions | Shrinkage: Weft wise: 0.8% Warp wise: 0% Melting, dripping, Ignition: No | Pass |
| 6. | Tensile strength as per IS 1969 Part 1 | Tensile strength ≥ 450 N | Warp wise: 1056 N Weft wise: 987 N | Pass |
| 7. | IS 6489 Tear strength (Outer Layer) | Tensile strength ≥ 25 N | Warp wise: 38.6 Weft wise: 44.9 | Pass |
| 8. | Surface wetting ISO 4920 Spray test for Outer material | Spray rating ≥ 4 | 5 | Pass |
| 9. | ISO 5077 Cleaning- shrinkage resistance | Dimension Change ≤ 3% | Weft wise : 0.6% Warp wise : 1.0% | Pass |
| 10. | ISO 6530:2005 IS 15758 Liquid – Chemical Penetration Resistance Protection against liquid chemicals -Resistance of material to penetration by liquids | Shall have greater than 80% run-off & no penetration to the innermost surface i.e. Penetration= 0% & Repellency > 80% Resistance to Penetration: 1. 40% NaOH 2. 36% HCL 3. 30 % Sulphuric acid 4. White spirit | No penetration Repellency > 80% | Pass |
| 11. | Water-penetration resistance as per ISO 811 at 7kPa Water Penetration Resistance for 5 min | Shall not show appearance of water drops | No water penetration | Pass |
| 12. | ISO 11092 Measurement of thermal & water -vapor resistance under steady-state conditions (sweating guarded-hotplate test) | Ret ≤ 30m ² Pa/W | 27.7m ² Pa/W | Pass |



Fig. 3: Fire fighter suit developed by NITRA

1.2 Ongoing projects

- (i) **Project title** : New Approaches to Reduce Water Consumption in Textile Wet Processing (Sponsored by Ministry of Textiles, Govt. of India)
- Objectives** :
- To conduct preliminary trials to test suitability for various dyes, used for textile material
 - Designing and fabrication of equipment for dyeing and standardization
 - Conducting dyeing trial on various types of textile materials

- To compare dyed material out of new approach and conventional dyeing method in terms of quality and consumption of water

Progress of work :

- Water conservation/consumption study has been carried out in various mills
- Designing work of equipment for dyeing is in progress
- Various approaches of dyeing are being tested to conserve water
- Brief of approaches adopted are given below:

Approach-1: Exploring Possibilities of Dyeing Cotton Hank Using Soft Flow Dyeing Machine

Cotton dyeing is one of the most water consuming processes in dyeing industry; major load on ETP is only due to cotton treatment. Conventional cabinet Hank dyeing machine consume water in the range of 1:15 to 1:20 MLR. The salt, soda and other chemicals auxiliaries are used as per the MLR of machine. If MLR is high, the consumption of chemicals will also be on higher side. It was thought to use soft flow dyeing machine for dyeing cotton hank so the MLR can be reduce to 1:6 to 1:10. It will not only reduce consumption of water but also reduce chemical auxiliaries consumption and load on ETP. Also provide an option to the dyer having soft flow dyeing machine to dye yarn in hank form. Some of the dyeing trials taken using soft flow dyeing machine to dye cotton yarn in hank form are given below in the Table 3 :

Table 3 : Results of some of the Dyeing trials :

| Trial | Material to liquor ratio | Total water consumption (liter/kg) | Observation |
|----------------|---------------------------------|---|--|
| Trial 1 | 1:15 | 161 | Even shade, high entanglement |
| Trial 2 | 1:10 | 107 | Even shade, high entanglement |
| Trial 3 | 1:8 | 88.5 | Achieved even dyeing |
| Trial 4 | 1:7 | 77.5 | Due to poor liquor circulation dyeing was uneven, entanglement |

This study shows (Trial 3) that cotton hank can be dyed in soft flow dyeing machine using 1:8 MLR. Shown in Fig. 4 and Fig. 5 below :



Fig. 4: Soft flow dyeing machine used for cotton hank dyeing



Fig. 5: Dyed Cotton hanks

Approach-2: Dyeing Cotton Fabric in Solid Shade Using Disperse Dye

To dye cotton fabric, reactive dye is one of the best suitable methods. It also gives good fastness properties as required. For cotton dyeing with reactive dye requires 5 to 6 washes after dyeing to remove the unfixed dye. Due to high colour discharge and chemical in effluent it increases the load on ETP and cost of treatment. In this approach we have tried to develop a solid shade using disperse dye on cotton fabric.

In disperse dyeing the amount of color and chemical in effluent is comparatively less than reactive dye. It also saves time during dyeing and require less number of washes to remove unfix dye. The lab trials results are shown in Fig. 6 below :



Fig. 6 : Cotton Fabrics dyed in solid shades using disperse dye

Approach-3: Creating Denim Effect using Disperse Dye on Cotton Fabric

Denim industry is one of the most water consuming industry. Mostly vat and sulphur dyes are used to produce denim fabric. It has a limitation to produce different shades. In this approach we use **Pad-Cure-Dyeing** method to Produce denim effect using **Disperse dye** on different twill fabric. Result are shown in Fig. 7 below:

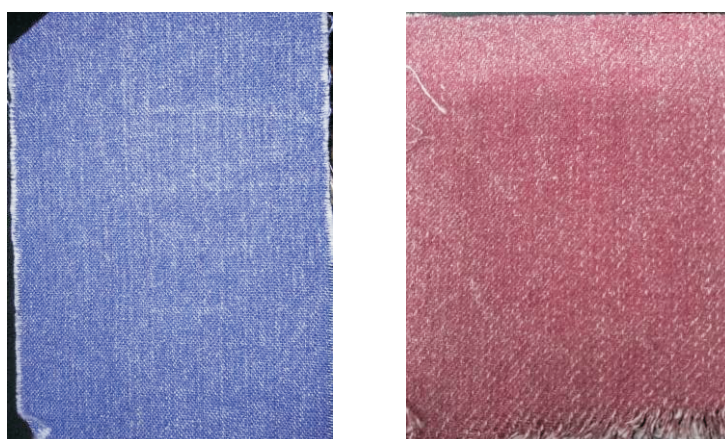


Fig. 7 : Cotton Fabrics having denim effect created by using disperse dye

(ii) **Project title** : Development of value added product from different Fibres in Himalayan Region (Sponsored by Ministry of Textiles, Govt. of India)

Objectives :

- To standardize a method for extraction of fibers from Pine Needles, Indian Flax, Nettle etc.
- Development of machines for extraction of fibres
- To produce yarn with pure fibres and blends by optimizing mechanical parameters
- To develop various kinds of fabric utilizing those yarns
- To develop final value added products / home textile using these fabrics

Progress of work :

- Cultivation of flax fibres has been done
- Extraction of fibre from Pine leaves has been standardized
- Machinery manufacturer has been identified and purchase process has been completed
- A patent has been filed regarding extraction of textile grade fibre from pine needles
- Products have been developed (Refer Fig. 8)



Fig. 8 : Some of the value added products developed

Background:

High level of poverty in hills persists due to low employment opportunities. Average monthly income of agricultural households in Uttarakhand is around Rs.4,700/- per month as compared to around Rs.8,800/- per month in neighboring Himachal Pradesh.

Considerable migration of people from hills to plains in search of livelihood affecting development of hills. As per report of Economic Times (06.05.2018) approx 4 lakh people have migrated in past 10 years from their native villages of Uttarakhand. Problem is that opportunities available in this region is not exploited.

The fact is that Himalayan region has been bestowed with enormous nature's fibre wealth, including pine needles. These have been used by the locals for their needs. These natural fibres can be exploited to improve the livelihood of hill people. But on the other hand the most negative and damaging impact is that many times, pine needles (perul), lying in the Himalayan region in abundance, catch fire and become highly

combustible after these get dry. And this leads to a forest fire causing huge losses to the people living in the region. So its better to exploit the use of natural fibres to bring the happiness to the hill people by upbringing their livelihood and earnings. Considering this need, NITRA got involved in development of value added products using the fibres extracted from Pine needles and from different other fibrous plants, which are available or can be grown in Himalayan region such as Ramie (*Boehmeria nivea*), Flax (*Linum usitatissimum*) and Hemp (*Cannabis sativa*), pine needle etc. It has been observed that the products developed from these fibres have very high domestic and export demand. Indigenous flax fibres have very good probability of replacing flax fibres which are imported from European countries. Huge demand of high value garments produced from flax fibres can be a boost for the local people of Himalayan region.

Experiments were carried out for exploring the possibilities of using natural fibres abundantly available in Himalayan region. Brief details of experiments are given below:

Experimental work:

The pine needles were collected from the ground of Almora, Uttarakhand and neighbouring areas where Pine forests are abundantly available. Those needles were brought to NITRA, Ghaziabad and extraction of fibres was attempted. Various chemical combinations were tried to get the best textile grade fibres. Sodium hydroxide (NaOH) solution was used for preliminary treatment and then Aluminium chloride (AlCl_3) solution was used for final treatment. After a number of trials, optimum time, temperature and concentration(gpl) were finalised. Then the fibres were extracted by mechanically rubbing the treated leaves and dried.

For producing Indian Flax proper seeds were required. It was observed that Central Research Institute for Jute & Allied Fibres (CRIJAF) under ICAR had undertaken some trials and they have developed a variety of JRF2 which gives good result in Indian atmosphere. But large scale trials were not been taken for commercialization. NITRA procured seeds from them and planted in around 7 acres of land during 2017-18. Five acres of land was at G.B. Pant University of Agriculture & Technology, Pantnagar, Uttarakhand and around 2 acres of land was at NITRA, Ghaziabad. The sowing time was November end to beginning December 2017 and the plants were harvested during April, 2018. Fibres were extracted after retting and scutching was done.

Results & Discussion:

The properties of the extracted pine needle fibres were assessed. These are shown in Table-4 "Physical properties of Pine needle fibres". As the fibres have low tenacity value it was blended with cotton fibre and yarns were spun. The SEM photographs of the cross section of the pine needle fibres and longitudinal structure have been shown in Fig.9 to Fig.12. Both Fig.9 and Fig.10 show the cross-sectional view of pine needle fibres at different magnifications. The figures show a hollow structure which is different from conventional natural fibres used in common. The Fig.11 and Fig.12 show the longitudinal view of pine needle fibres which are not fully cylindrical and somehow looks rough. It was observed that it has high moisture regain value (around 12%). It is expected that this hollow structure will result in products with high thermal resistance value and good water absorbency.

Table 4: Physical Properties of Pine needle fibres

| Parameters | Pine needles |
|-------------------------|--------------|
| Tenacity (g/den) | 1.10 |
| Min. | 0.32 |
| Max. | 3.63 |
| Average | 1.10 |
| CV% | 66.80 |
| Elongation% | 5.94 |
| Min. | 0.80 |
| Max. | 10.10 |
| Average | 5.94 |
| CV% | 41.25 |
| Count (Denier/Ne) | 87.69/60.61 |
| Bundle strength (g/tex) | 5.64 |
| Elongation% | 6.9 |

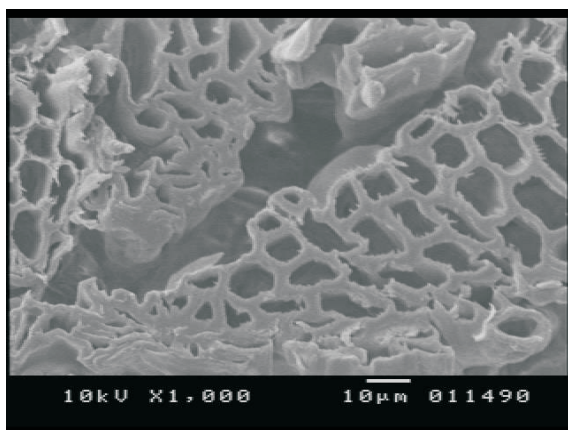


Fig. - 9

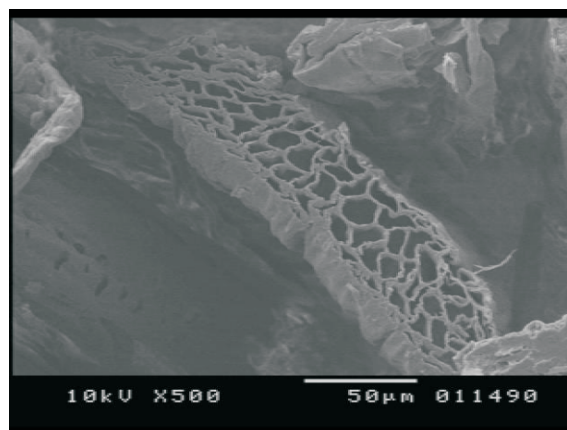


Fig. - 10

Fig.9 and Fig.10 show the cross-sectional view of pine needle fibres at different magnifications.

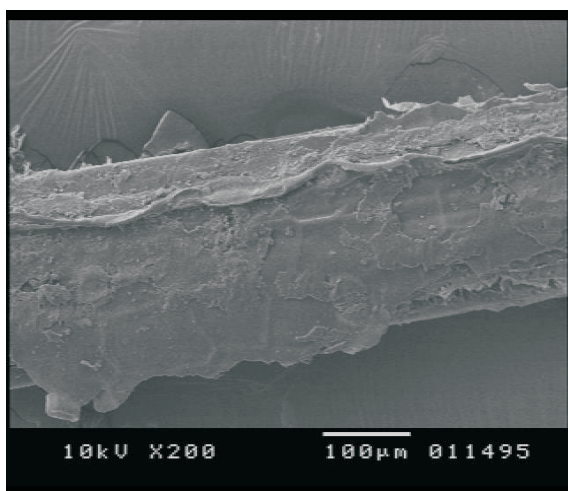


Fig. - 11

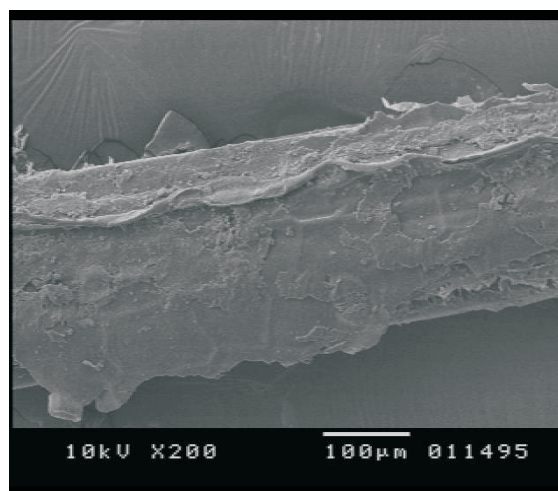


Fig. - 12

Fig.11 and Fig.12 show the longitudinal view of pine needle fibres.

The flax fibres, produced in India, were assessed for their various properties and the same were compared with the some of the European flax, sourced from a commercial fabric manufacturer. The SEM photographs of the flax fibres are shown in Fig. 13 to 16. Both Fig. 13 and Fig. 14 show the cross sectional view of the flax fibres and different magnification. It can be seen that the fibres are mature and similar to available fibres elsewhere. The Fig. 15 and Fig. 16 show the longitudinal view of Indigenous flax fibres at different magnifications. The properties are shown in Table-5. It can be seen from the Table that there is no significant difference in properties of these fibres. However, single fibre tenacity of Indian flax is lower than imported fibre, but the bundle strength of Indian fibre is higher. The appearance shows small difference and the Indian variety looks little harsher. This may be the reason for having higher bundle strength as compared to the bundle strength of imported fibres.

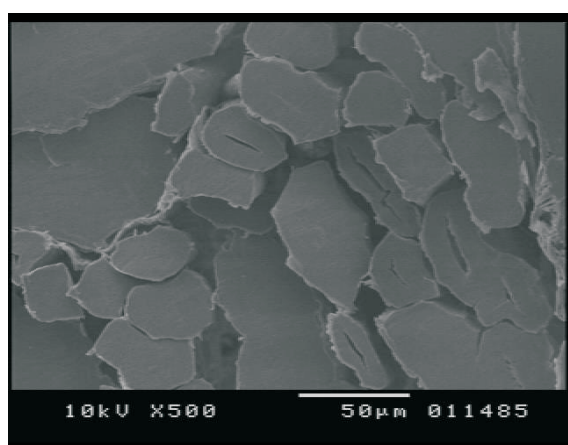


Fig. - 13

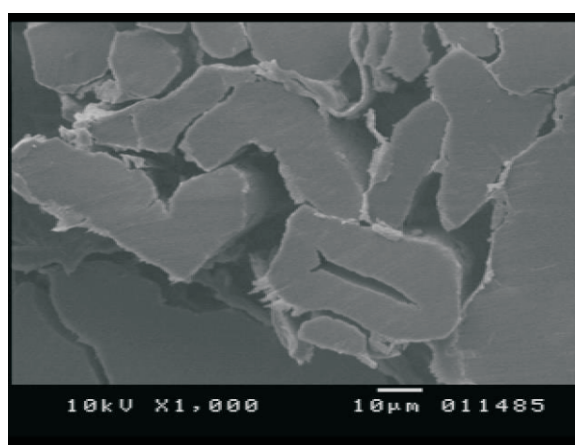


Fig. - 14

Fig.13 and Fig.14 show the cross sectional view of the flax fibres and different magnification.

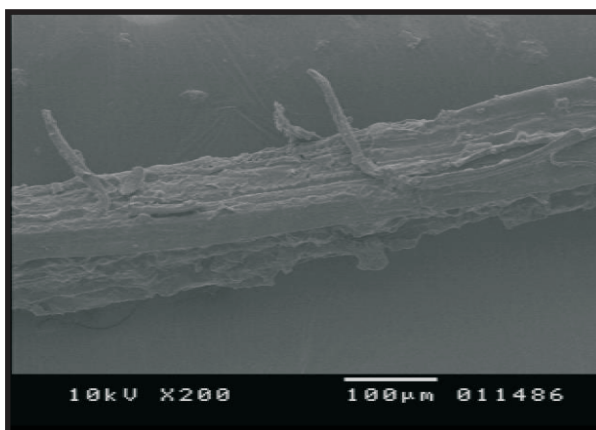


Figure - 15

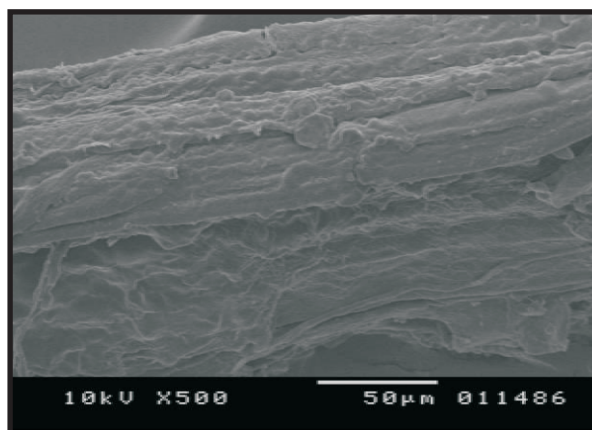


Figure - 16

Fig.15 and Fig.16 show the longitudinal view of Indigenous flax fibres at different magnifications.

Table 5: Physical Properties of Flax fibres

| Parameters | Indian flax | Imported flax |
|-------------------------|--------------|---------------|
| Tenacity (g/den) | 3.43 | 4.18 |
| Min. | 0.56 | 0.86 |
| Max. | 7.34 | 7.19 |
| Average | 3.43 | 4.18 |
| CV% | 48.77 | 42.05 |
| Elongation% | 2.11 | 2.26 |
| Min. | 0.70 | 0.70 |
| Max. | 4.50 | 4.40 |
| Average | 2.11 | 2.26 |
| CV% | 41.38 | 35.12 |
| Count (Denier/Ne) | 40.81/130.24 | 38.52/137.98 |
| Bundle strength (g/tex) | 63.49 | 40.82 |
| Elongation% | 0.61 | 0.75 |

The pine needle fibres (PNF) have been blended with cotton in different ratios and it was found difficult to spin yarn as the percentage of PNF fibres increases. Also it is observed that there is preferential loss of PNF in carding, resulting in less PNF percentage in resultant yarn. The yarns with 70:30 Cotton: PNF (actual in yarn stage) was successfully spun and yarns were sized and woven into fabrics using loom. The fabrics have unique look and it will be useful to produce home textiles and apparels.

The Indian flax fibres were processed in very small scale in a commercial company in Eastern India which is the leader in flax processing. The fabric produced in small scale was found as good as that of produced from imported flax fibre. This preliminary small scale trial showed that yield is much lower (to the extent of 50%) during spinning operation. This is due to improper extraction of fibre and scutching of Indian flax fibre. The scutching was done using crude manual method which needs to be improved to get better yield of yarn from fibre.

Findings of experiment:

The results show that there is a very good possibility of producing high value textile products using Pine needles which are abundantly available as plant waste and can help improve the economy of Himalayan region. Also it will help in reduction of forest fire which is the cause of huge loss of human and animal life.

Flax fibre produced in India can replace the use of imported flax fibre, thereby, reducing import and generating income for the people living in the Himalayan region.

(iii) Project title : Development of air cleaner home textiles to reduce Indoor air pollution (Sponsored by Ministry of Textiles, Govt. of India)

Objectives :

- Understanding nature of air pollutions in the indoor places using primary and secondary data and preparing research design
- To evaluate various finishing chemicals/materials having characteristics to absorb/reduce air pollution
- To select suitable fabrics and apply selected finishing chemicals using various techniques
- To evaluate finished fabrics for various physico-chemical and performance properties
- To take field trial of developed fabric in actual practice and modify, if required

Progress of work :

- Collecting details of air pollutants present in indoor air using primary and secondary data has been done
- Identification of finishing chemicals required to reduce indoor pollution are going on through available sources
- Procurement of some finishing chemicals has been done
- Application of various finishing chemicals on fabric has been done
- Preliminary testing has been done using different methods
- Fabrication of testing instrument for pollution absorbing textile has been completed (Refer Fig. 17)
- Air quality monitoring system has been procured
- Design of pollution absorption box (a part of instrument) finalized and ordered for fabrication

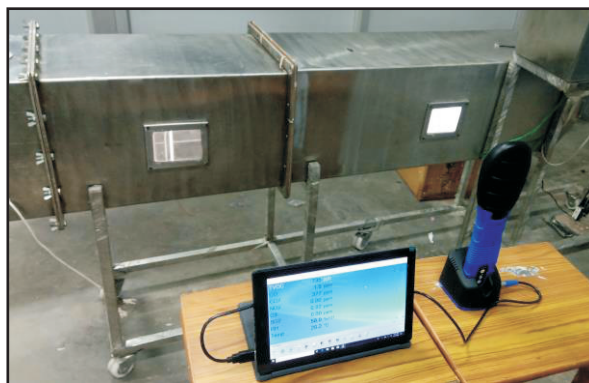


Fig. 17 : Fabricated Testing Instrument

(iv) **Project title** : Setting up of Common Effluent Treatment Plant (CETP) -150 KLD at Ajrakhpur, Bhuj (Sponsored by Ministry of Textiles, Govt. of India)

Objectives :

- Environment protection
- Ground water saving
- Energy conservation through reduction in ground water lifting
- To increase investment opportunity
- Creation of employment opportunities through overall business growth

Scope of work :

- Preparation of DPR with detailed BOQ
- Preparation of drawings, tendering & tender evaluation
- Supply, construction, installation of all civil units as per the design and drawing
- Supply & installation of electro-mechanical equipment as per the design and specification
- Piping work and Hydraulic testing
- Setting-up of testing lab
- Commissioning of CETP and performance analysis
- Training of manpower
- 6 months hand holding

The foundation stone of the Common Effluent Treatment Plant (CETP) was laid on March 18, 2017 by Union Textile Minister Smt. Smriti Zubin Irani.

Progress of work :

- Detailed project report (DPR) has been prepared, contract awarded through tendering
- Prepared environmental impact assessment report
- Environmental clearance (EC) obtained
- Consent to Establish (CTE) has been granted by the Gujarat Pollution Control Board
- Fabrication of MS tanks is partly completed
- Civil work is underway

2. IN-HOUSE PROJECT

2.1 Completed Project

(i) **Project title** : Development of an Android-based Mobile Application for garment industry for Instant Information Access and Quick Decision Making

Objectives : Indian Garment Industry, especially exports, mainly comprises of small and medium size manufacturing units. Most of SME's do not have any MIS such as ERP due to reasons such as very high cost, customization and maintenance issues due to which the top management is unable to access correct information at the right time. Keeping these factors in mind, NITRA planned to develop a Mobile App that would address most of these issues. The App will have following modules: (Shown in Fig. 18 given below)

- Fabric Re-conciliation
- Cutting
- Sewing
- Finishing
- Packing
- Cut to Pack Status



Fig. 18 : Modules of App

Research outcome :

- Survey was conducted in garment units to understand top management requirements and usefulness of the APP
- Visits to garment units were undertaken to understand prevailing methods of information gathering
- All the above-mentioned modules are now ready
- Internal testing of the App is in process
- After completing the internal testing, the APP will be launched commercially
- The App is named as “**APPRISE (Apparel Production Information System for Enterprises)**”
- Brief details of each module of the App are given below:

Fabric Re-conciliation: Fabric Reconciliation is an important activity in garment industry as fabric cost is almost 50-60 percent of total garment cost. The activity includes analysis of quantity of fabric purchased by a unit for each job order, quantity of fabric actually used according to order quantity, quantity of fabric left after shipment and how much fabric is lost as wastage in the process.

In the Fabric Reconciliation module of the App, we can see buyer-wise monthly Fabric reconciliation report for all job numbers. This App helps us to keep a check on fabric consumption as per planned and actual cutting average. It also gives us utilization percentage for each job number.

Cutting: In this module of the App, we can check the status of any order buyer wise/ style wise. All the details of a particular job order like fabric, color and cut quantity and balance to be cut can be verified easily. This will help the garment unit to do cutting room planning more efficiently so that input from cutting to sewing remains uninterrupted.

Sewing: Sewing means attachment of different parts of the cut panels together as per design. It is the most important process in garment manufacturing and generally involves highest number of manpower.

In this module of the App, one can check total pieces issued, total pieces received and balanced quantity for a particular job number, which will further help us to plan our production floor in better and effective manner.

Finishing: The App help us to check the current finishing status of every job number.

Packing: The App helps us to check the current packing status of every job number.

Cut to Pack Status: Under this section, one would be able to see the complete status of every order starting from cutting to packing.

The App is very user friendly and also has features like sharing, print and download and a very easy data input system. APRRISE provides a complete end-to-end solution to the user.

3. INDUSTRY SPONSORED PROJECTS

3.1 Completed Project:

- (i) Development of Improved version of body protector used for riots control

3.2 On-going Projects:

- (i) Development of coat combat disruptive
- (ii) Development of technical textile products in the field of feminine hygiene

4. PROPOSED PROJECTS

(i) **Project title** : Development of stab, impact and puncture testing instrument for body protector

Sponsoring Agency : Department of Science & Technology, Govt. of India

(ii) **Project title** : To initiate a process for making rural women economically self-reliance by engaging them to convert agriculture bio mass waste in to useful products

Sponsoring Agency : Department of Science & Technology, Govt. of India

(iii) **Project title** : To develop protective work-wear for sewage and sanitary workers

Sponsoring Agency : Department of Science & Technology, Govt. of India

(iv) **Project title** : Development of protective work wear for fire safety of women working in fire hazard areas such as kitchen, matchsticks manufacturing, brick firing & fire work industry

Sponsoring Agency : Department of Science & Technology, Govt. of India