: Development of multi layered flame & thermal resistant fabric for fire-fighter clothing (Sponsored by Ministry of Textiles, Govt. of India)

:
- 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 $I_{Q\cdot24}\geq13$ $(I_{Q\cdot24}- I_{Q\cdot12})\geq4$	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}) $t_2 \geq$ 22sec ii) ($t_2 - t_1$)HTI_{24}-$HTI_{12} \geq$ 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 $\geq$ 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 $\geq$ 450 N	Warp wise:1056 N Weft wise: 987 N	Pass
7.	IS 6489 Tear strength (Outer Layer)	Tensile strength $\geq$ 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 $\leq$ 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 $\leq$ 30m^2 Pa/W	27.7m^2 Pa/W	Pass

Fig. 3: Fire fighter suit developed by NITRA